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Up-to-Date Methods of Selling Steam

How the Largest Central Heating Company in the United States Goes After New Business.

By CLAUDE HARTFORD,
Sales Engineer, Contract Department, New York Steam Company.

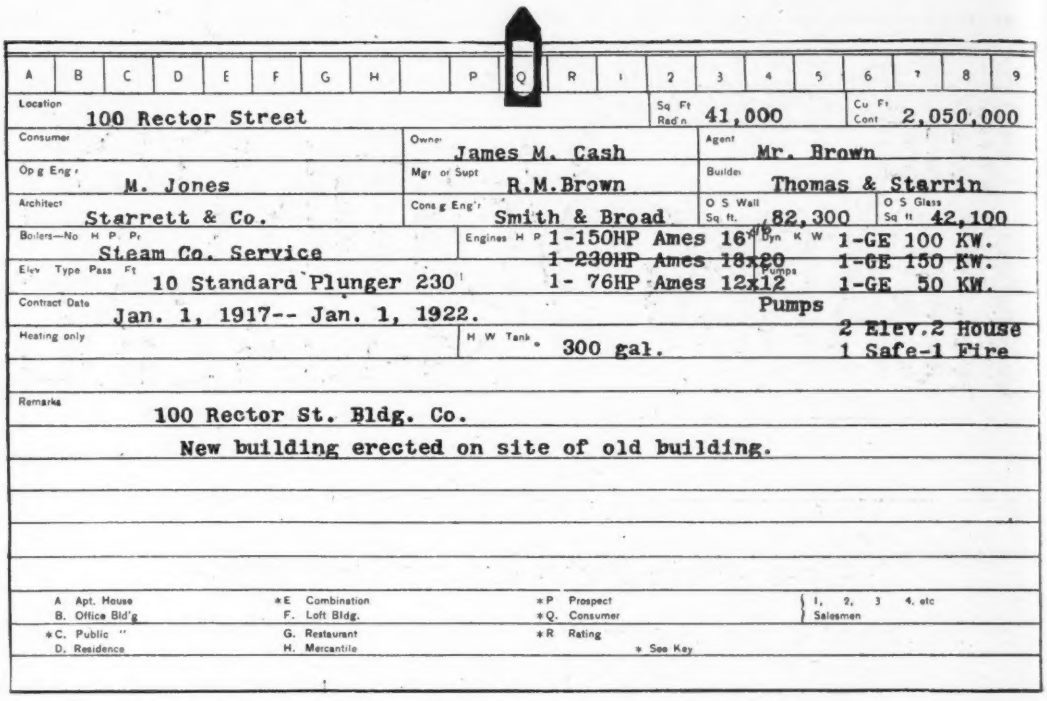
When the New York Steam Company, which, by the way, is the oldest public service corporation in the city and the largest central station steam company in the world, passed into the hands of the new interests that now control it, two years ago, one of the first things that happened was the total rehabilitation of its plants and distribution system. This was followed, in short order, by the organization of a "Contract Department," in which a system was installed for maintaining a complete record of data relative to both new and old business. So much new business has been obtained under this method and so well distributed a load secured that the details of the system should prove of value to all who are interested in the sale of district heat. The inception of the plan is due to Charles H. Gillham, vice-president of the company, whose long experience in the central heating field recently in New York and previously as vice-president of the Central Station Engineering Company, of Chicago, has enabled him to incorporate the best features of other heat selling schemes in the method here described.

In presenting the company's sales record system, it should be understood that the company operates two systems in New York City, one in the down-town financial district where steam is served to a majority of the most important business buildings; and the other up-town, serving what has been described as "the most exclusive residential district in the world."

It may not be generally known that in the down-town district most of the office buildings have their own plants for the generation of electrical current for both power and light. These buildings take steam from the street service to drive their generating engines. After years of service, this method has proved both practical and economical. Due to the increased demand for such service, a new station is nearing completion at Burling Slip and Water Street, of 24,000 H.P. capacity, which is the last word in engineering, from the standpoint of both construction and operation.

Due to the division of the company's service into two systems and to the different class of service rendered, for the most part, by each system, it was necessary, in the first place, to have the sales records divided in the same way.

A card and map system is used, Figs.



A | B | C | D | E | F | G | H | | P | Q | R | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9

Location: 100 Rector Street — Sq Ft Rad'n: 41,000 — Cu Ft Cont: 2,050,000

Consumer — Owner: James M. Cash — Agent: Mr. Brown

Op g Eng'r: M. Jones — Mgr or Supt: R.M.Brown — Builder: Thomas & Starrin

Architect: Starrett & Co. — Cons g Eng'r: Smith & Broad — O S Wall Sq. ft.: 82,300 — O S Glass Sq ft: 42,100

Boilers—No H P Pr: Steam Co. Service — Engines H P: 1-150HP Ames 16x20 Dyn K W 1-GE 100 KW. ~~1-230HP Ames 18x20~~ 1-GE 150 KW. — Elev Type Pass Ft: 10 Standard Plunger 230 — 1- 76HP Ames 12x12 Pumps 1-GE 50 KW. Pumps

Contract Date: Jan. 1, 1917-- Jan. 1, 1922. — 2 Elev.2 House 1 Safe-1 Fire

Heating only — H W Tank: 300 gal.

Remarks: 100 Rector St. Bldg. Co.
New building erected on site of old building.

A Apt. House; B. Office Bld'g; *C. Public "; D. Residence
*E Combination; F. Loft Bldg.; G. Restaurant; H. Mercantile
*P Prospect; *Q. Consumer; *R Rating
1, 2, 3 4, etc Salesmen
* See Key

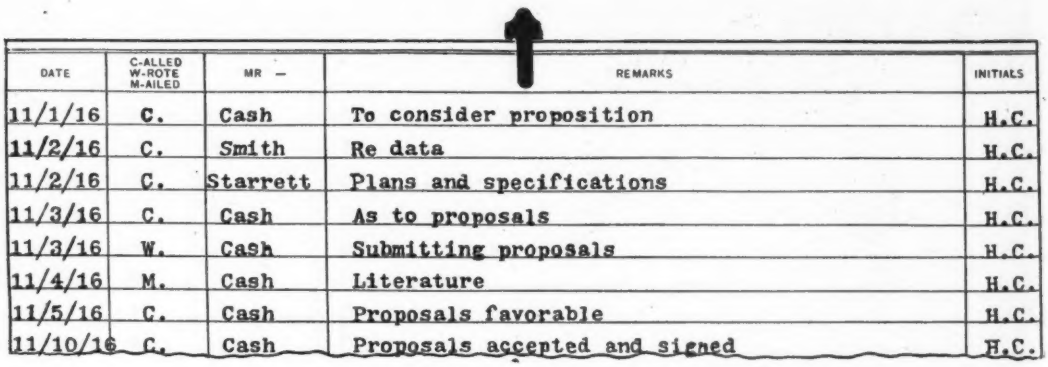
FIG. 1—FRONT OF SALES RECORD CARD, WITH TYPICAL ENTRY.

1 and 2 being reproductions of the front and back of a typical card. These cards measure 5 in. x. 8 in., being of standard size for filing. For the up-town district a salmon-colored card is used, while that for the down-town district is buff-colored. On the face of the card, as will be noted are recorded all the necessary data, as shown under the various headings.

At the top of the cards, in the center, will be seen the letters "P" and "Q." "P" indicates a prospect and "Q" indicates a consumer. Metallic signals are employed to designate the classification of any particular card. In the illustration, for instance (Fig. 1), the signal is over "Q" showing that this particular party is a consumer.

Other signals are provided for use on the cards. A green signal indicates a power consumer; a yellow signal indicates a heating consumer; a red signal shows a power prospect and a blue signal stands for a heating prospect. As every card has one signal on it and that one is placed on either the "P" or the "Q," the contrast of consumers against prospects in the card file is readily seen.

There is a card for every building plot on every main. The cards are filed alphabetically by streets, the street names



DATE	C-ALLED W-ROTE M-AILED	MR —	REMARKS	INITIALS
11/1/16	C.	Cash	To consider proposition	H.C.
11/2/16	C.	Smith	Re data	H.C.
11/2/16	C.	Starrett	Plans and specifications	H.C.
11/3/16	C.	Cash	As to proposals	H.C.
11/3/16	W.	Cash	Submitting proposals	H.C.
11/4/16	M.	Cash	Literature	H.C.
11/5/16	C.	Cash	Proposals favorable	H.C.
11/10/16	C.	Cash	Proposals accepted and signed	H.C.

FIG. 2—BACK OF SALES RECORD CARD, WITH TYPICAL ENTRY.

being printed on regular cardboard card indexes. Under each street the cards are filed numerically, according to lot numbers. It has been found that in looking up a proposition the location of the consumer or prospect is known, and hence the foregoing method of filing.

The numerals at the top of the card, on the right (Fig. 1) are used to designate the sales engineer who has charge of the prospect. The various prospects on the mains are assigned to the different sales engineers and a white duplicate of the master card is given each one of them. On the back of the card (Fig. 2) space is provided for notes as to dates, persons interviewed or written to, literature sent, remarks and initials of the sales engineer. The notes made on the white card are regularly transferred to the master cards.

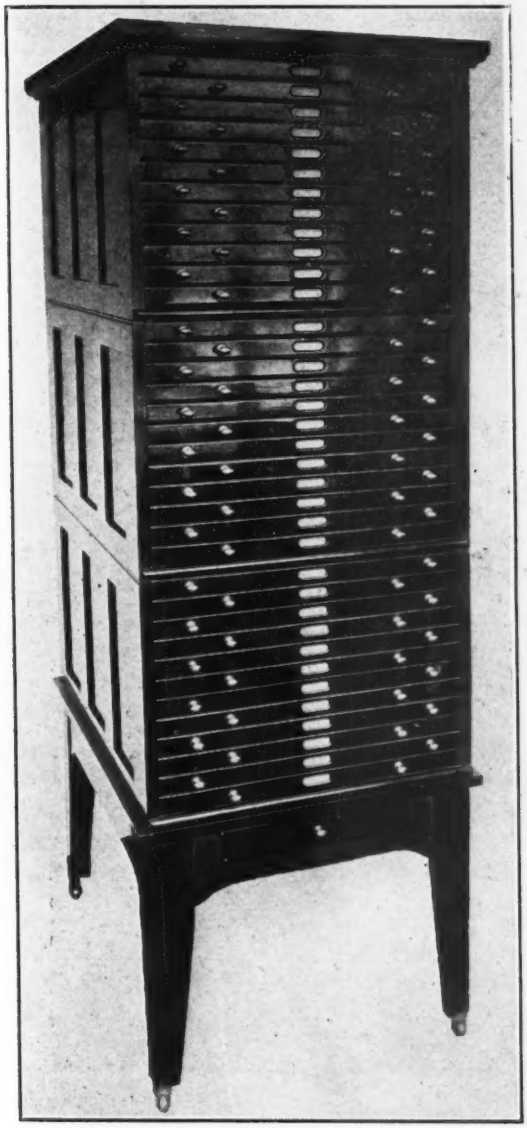


FIG. 3—MAP CABINET FOR DOWNTOWN DISTRICT.

In the typical case illustrated in Fig. 1, the data show the principal facts regarding the building at 100 Rector Street, New York, including the contents, 2,050,000 cu. ft.; the radiation, 41,000 sq. ft.; owners, etc. It will be noted that the building has no boilers, being supplied by steam company service.

On the back of the card (Fig. 2) the record shows that the proposition was first brought to the owner's attention on November 1, 1916 by a personal call. On the 2nd, the representative called on the consulting engineer to obtain the data afterwards listed on the front of the card. The same day, the representative called on the architect to obtain plans and specifications. On the 3rd, the representative called "as to proposals, and on his return to the office wrote the owner, submitting the company's proposals. The next day he mailed the owner some literature bearing on the proposition. He called the next day to find that the proposals were being favorably considered by the owner of the building and five days later, on November 10, the contract was closed during a personal call.

The map system used in conjunction with the cards is very elaborate in detail. These maps are kept flat in cabinets. For the down-town district there are 34 maps in as many drawers. Fig. 3 shows one of the cabinets which is located conveniently in a corner of the "Contract Department."

In the first drawer of each cabinet is an index map (Fig. 4) with a key (Fig. 6) showing in what drawer to look for the detailed map of any particular section. Fig. 5, for instance, is a detail map of Section 11, filed in drawer No. 11. The maps show by symbols, colors, etc., all data relative to the various buildings upon the lots, besides the size and location of steam mains and services.

In addition to this, a vital feature of the system is the use of different-colored tacks, the colors corresponding with those on the signals in the card file.

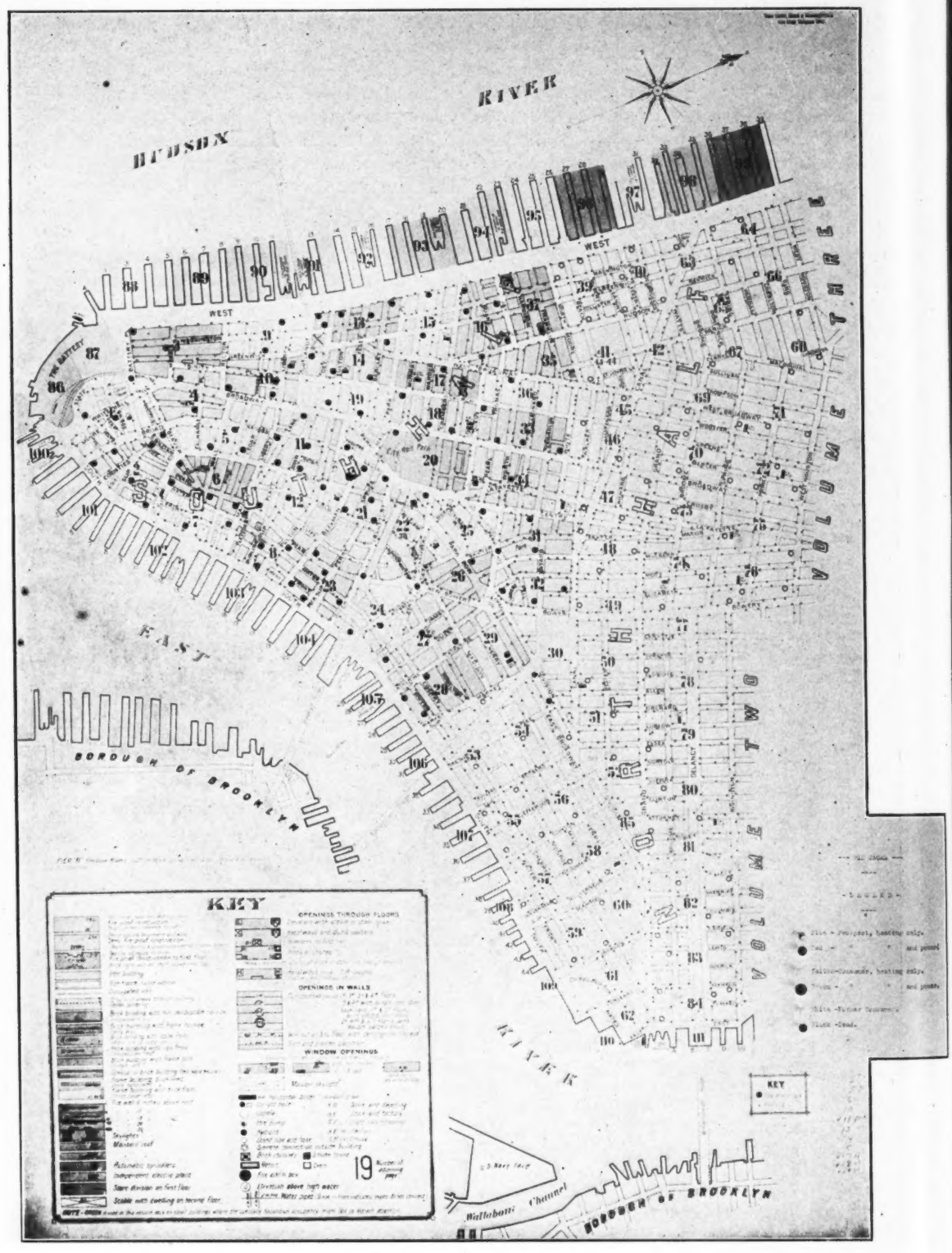


FIG. 4—KEY MAP OF DOWNTOWN DISTRICT, NEW YORK CITY AS COMPILED BY NEW YORK STEAM COMPANY.

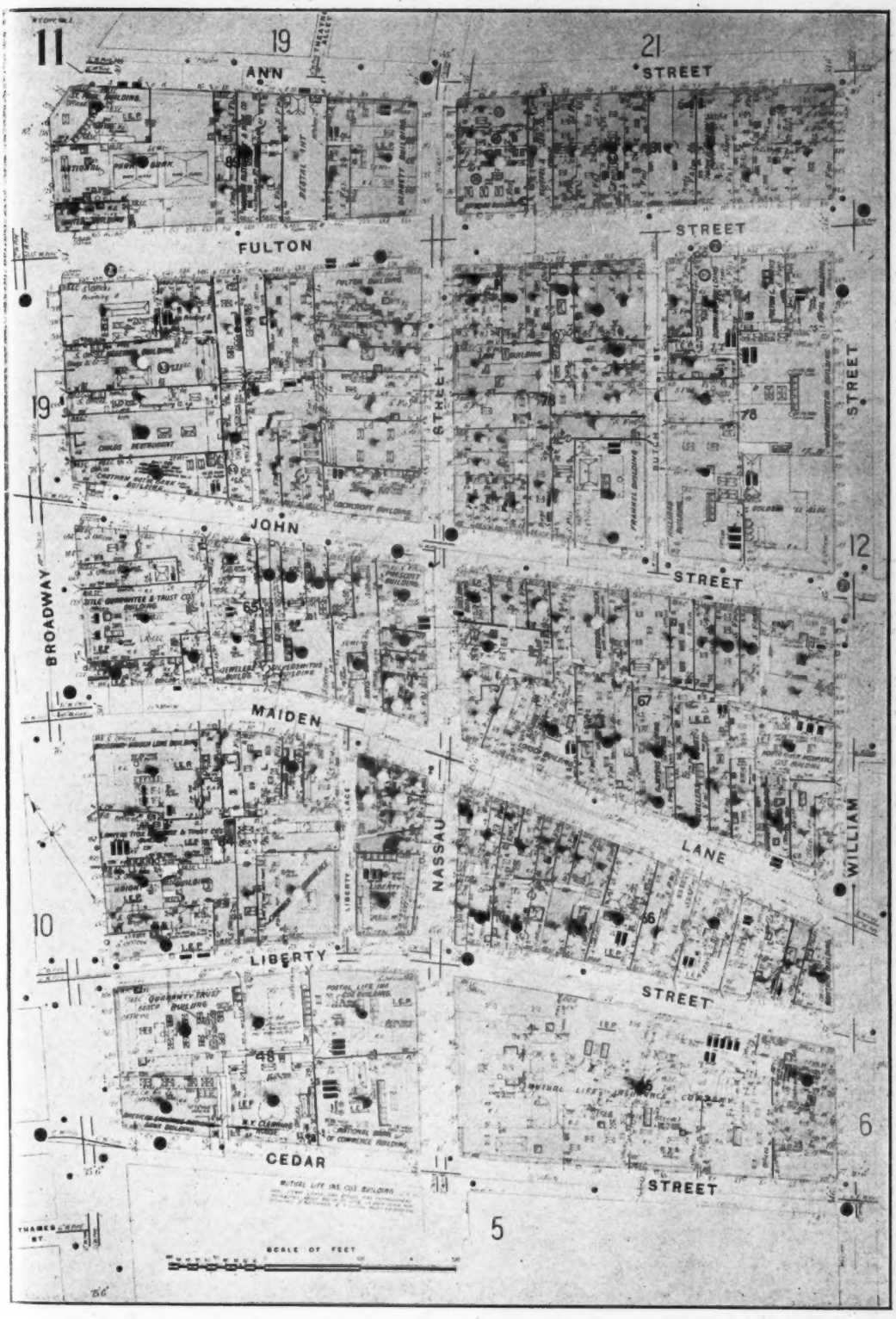


FIG. 5—MAP OF SECTION 11, DOWNTOWN DISTRICT, NEW YORK CITY, WITH PIN INDICATIONS TO SHOW PRESENT AND PROSPECTIVE SERVICE.

Fig. 5, for instance, illustrating Section 11 of the down-town district, is honeycombed with tacks that tell, at a glance, the exact conditions relative to the use of central station heat and power of any building in that section. As a further contrast the tacks used for consumers are round, flat and cloth-covered, while those indicating prospects are glass spheres of smaller diameter.

Where the company's service is connected to a building with no consumer as, for example, where a consumer moves out, a white glass tack is placed on that building, besides the red and blue tack, for further contrast. The "object of the game" is to replace all red, white and blue tacks with green and yellow tacks.

When the sales engineer turns in a signed contract from a new consumer, the signals are at once changed on the card file from the "Prospect" to the "Consumer" side and the contract date noted in the space provided. Then the "Prospect" tack on the map is changed to a "Consumer" tack and the service pipe drawn in on the map, if the building has not one already installed. In this manner an orderly, up-to-the-minute record is kept of the development of the business.

This system has proved very satisfactory and is in keeping with the other developments in the reorganization of the New York Steam Company, which are making for its success. The advantage of the system is that it tells at a glance the exact conditions in any section or building and may be understood and used not only by the salesmen themselves but by all the officials of the company who may require such information.

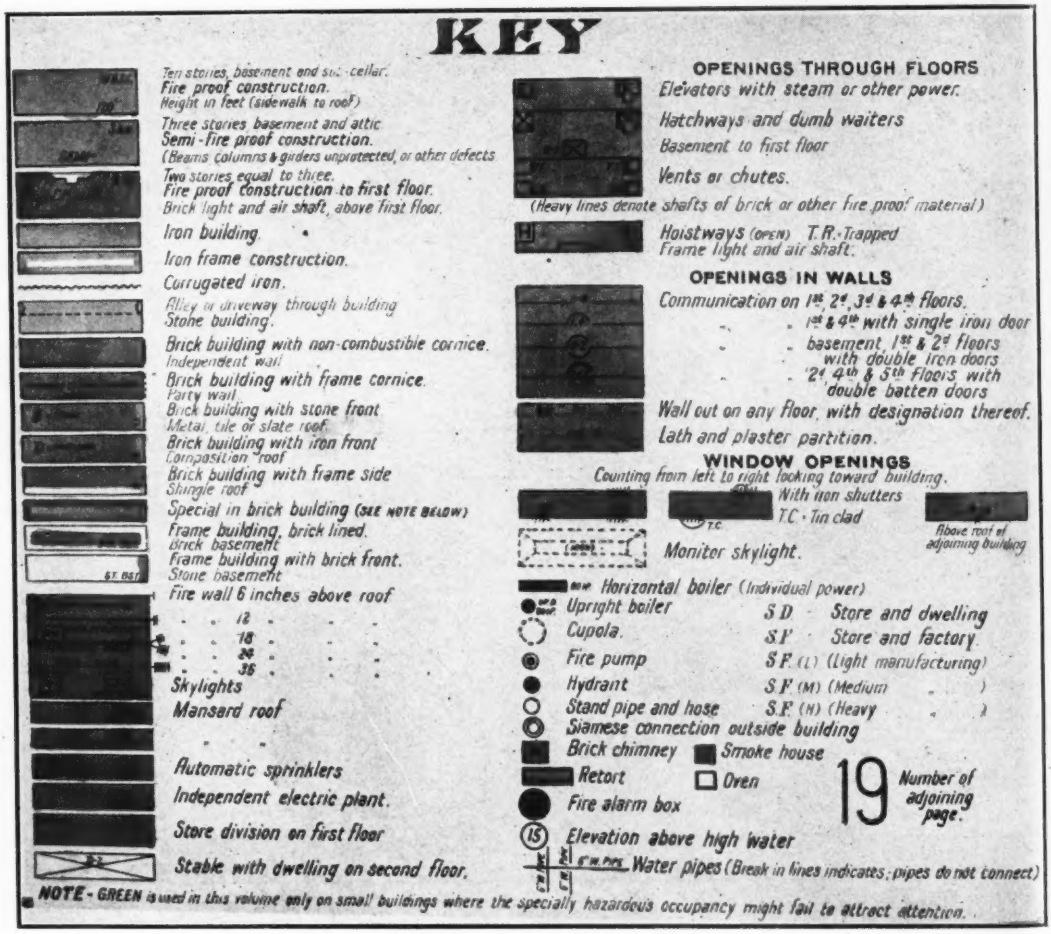

KEY
Ten stories, basement and sub-cellar. Fire proof construction. Height in feet (sidewalk to roof)
Three stories, basement and attic. Semi-fire proof construction. (Beams, columns & girders unprotected, or other defects.
Two stories, equal to three. Fire proof construction to first floor. Brick light and air shaft, above first floor.
Iron building.
Iron frame construction.
Corrugated iron.
Alley or driveway through building.
Stone building.
Brick building with non-combustible cornice. Independent wall.
Brick building with frame cornice. Party wall.
Brick building with stone front. Metal, tile or slate roof.
Brick building with iron front. Composition roof.
Brick building with frame side. Shingle roof.
Special in brick building (SEE NOTE BELOW)
Frame building, brick lined. Brick basement.
Frame building with brick front. Stone basement.
Fire wall 6 inches above roof.
12
18
24
36
Skylights.
Mansard roof.
Automatic sprinklers.
Independent electric plant.
Store division on first floor.
Stable with dwelling on second floor.
OPENINGS THROUGH FLOORS
Elevators with steam or other power.
Hatchways and dumb waiters.
Basement to first floor.
Vents or chutes.
(Heavy lines denote shafts of brick or other fire proof material)
Hoistways (OPEN) T.R.-Trapped. Frame light and air shaft.
OPENINGS IN WALLS
Communication on 1st, 2d, 3d & 4th floors.
1st & 4th with single iron door.
basement, 1st & 2d floors with double iron doors.
2d, 4th & 5th floors with double batten doors.
Wall out on any floor, with designation thereof.
Lath and plaster partition.
WINDOW OPENINGS
Counting from left to right looking toward building.
With iron shutters.
T.C.-Tin clad.
Monitor skylight.
Horizontal boiler (Individual power)
Upright boiler
Cupola.
Fire pump
Hydrant
Stand pipe and hose
Siamese connection outside building
Brick chimney
Smoke house
Retort
Oven
Fire alarm box
Elevation above high water
S.D. - Store and dwelling
S.F. - Store and factory
S.F. (L) (Light manufacturing)
S.F. (M) (Medium)
S.F. (H) (Heavy)
19 Number of adjoining page.
C.W. PIPE Water pipes (Break in lines indicates pipes do not connect)
NOTE - GREEN is used in this volume only on small buildings where the specially hazardous occupancy might fail to attract attention.

FIG. 6—KEY TO SECTION MAPS.

A Method of Determining the Probable Steam Consumption of a Building, under Given Conditions, from Central Service

By F. O. BROILI,

Northwestern Electric Co., Portland, Ore.

As is well known, the amount of heat required for buildings depends on a number of factors, and one of the important items is the class of service given, and the personal equation of the man (or men) in charge of the operation of the heat service.

For this reason, any formula that might be devised to determine the amount of heat required can be rendered worthless by a change of janitors. However, where there is no change of the class of service, and where reasonable care is given to maintain a uniform temperature, a formula for the requirements of the Northwestern Electric Company has been devised which appears to give excellent results for the short time it has been used.

It is sometimes necessary to know about what the consumption of a building should be between meter readings, where the meter has stopped. It is also necessary sometimes to explain to an irate customer why his bills have increased with a decrease in temperature, or why they should be higher or lower one year or one month as compared with another year or month.

The formula below is not intended to determine the amount of heat that would be required by a building, unless it has already been supplied with heat in some measurable form. The formula has been designed to apply to steam heat, but can be applied to any heat agent by slight changes.

The period "A," mentioned below, may be one week or one month or longer, as circumstances determine. Usually, the calculations are intended for monthly comparisons,—in which case it is important that the actual number of days be correctly determined.

The factors V_1 and V_2 are based upon average wind movement during the period in question, and these data are obtained from the U. S. Weather Bureau. It appears, from our investigations, that a wind under six miles per hour has little or no effect upon the heat requirements of a building.

The temperatures are obtained from the U. S. Weather Bureau, and care is taken that the average of the hourly readings is obtained. The published data of the Weather Bureau for the last few years is simply the average of

Formula for Determining Amount of Steam Required for a Given Period in Buildings Already Supplied with Heat.

M_1 = average amount of steam metered during period "A."
M_2 = probable average amount of steam used for a period "B."
I_1 = mean of hourly temperature for period "A."
I_2 = mean of hourly temperature for period "B."
V_1 = average wind velocity above 6 miles per hour during period "A."
V_2 = average wind velocity above 6 miles per hour during period "B."
W_1 = auxiliary consumption per day during period "A" and including steam for hot water, cooking, etc. This factor is not necessarily constant and will vary on certain classes of buildings and with certain types of installation.
W_2 = auxiliary consumption per day during period "B." This factor can be the same as W_1, but in many cases will vary with the time of the year for the period "B" selected.
$E_1 = (65 - T_1 + V_1)$ = equivalent temperature for period "A." This includes the variables that specifically affect the steam consumption; and, in effect, is the average equivalent temperature below 65° F.
$E_2 = (65 - T_2 + V_2)$ = equivalent temperature for period "B," based on variables used for period "A."
$S = \frac{M_1 - W_1}{E_1}$ = specific consumption. This is the consumption per day for each equivalent drop in temperature per degree Fahrenheit below 65°.
$M = SE_2 + W_2$.

the maximum and the minimum temperature during every 24-hour period.

The auxiliary consumption of W_1 and W_2 are the hot water requirements, etc., and which are independent of the actual heating requirements of the building. This amount can vary between summer and winter, depending upon the nature of the apparatus used. Many buildings are connected up so that the condensate heats all, or nearly all, of the hot water required for the building in the winter time; but in the summer time steam is required. In other cases (hotels, for instance), a practically constant amount of steam is used for cooking purposes. For this reason, judgment should be exercised so that consistent factors are obtained.

No claim is made for absolute accuracy, the formula merely giving results that connot be as readily obtained in any other manner. To show its application, the following are examples:

APPLICATION OF FORMULA.

A public building has been heated with its own system, and the amount of steam required measured. Upon taking service from the central station company, the consumption was about 30% higher. A comparison of a year with their own operation, and calculated requirements for the succeeding year, and the actual amount, were as shown in the table.

W_1 was summed as being 1,300 lbs. as that was the amount used during 1916 in August, and was used for hot water, the only auxiliary load.

It will be noted that the actual requirements are somewhat higher than the calculated totals, but this is explainable by the fact that a 2° higher temperature was maintained. This would have taken even more steam, but for the fact that the condensate, in the case of the central station service plant, was used in economy coils and it was estimated that one item about cancelled the other.

APPLYING FORMULA WHEN METER HAS STOPPED.

In the following case, the meter had stopped between the two 10-day meter reading intervals, and it was felt necessary to have some "educated" guess, so the formula was applied from the following data and with the results as given.

During period "B," December 30 to January 11, 1917, the steam metered was 137,000 lbs., but the meter was found stopped, ($E_2 = 22.5$) January 11 to 22. Applying the formula for this period gave 210,000 lbs.

STEAM REQUIRED FROM PRIVATE PLANT TO HEAT A GIVEN BUILDING COMPARED WITH THE CALCULATED AND ACTUAL AMOUNTS WHEN SUPPLIED FROM A CENTRAL HEATING PLANT

1915 M'th	No. Days	Actual Consumption 1915, 1,000 lbs.	E_1 1915	Per Cent	E_2 1916	No. Days 1916	Estimated Cons'ption 1916 $SE_2+W_2 \times N$	Actual Cons'ption 1916, 1,000 lbs.
Jan.	31	920	26.5	1,060	38.2	31	1,395	1,361
Feb.	28	715	20.1	1,200	24.3	29	844	867
Mar.	31	455	12.9	1,040	20.0	31	750	807
Apr.	30	346	10.2	970	13.2	30	495	474
May	31	325	7.9	1,180	11.6	31	452	362
June	30	165	3.0	1,400	3.6	30	163	188
July	31	gas	...		1.6	31	97	68
Aug.	31	gas	...		0.0	31	40	40
Sept.	30	137	3.9	845	3.5	31	164	122
Oct.	31	404	9.8	1,190	12.6	30	473	607
Nov.	30	725	20.1	1,140	23.0	30	830	864
Dec.	31	882	23.8	1,140	27.7	29	960	1,018
		5,074					6,662	6,778

S = 1145.
N = Number of days.
Average of January, February, November and December, 1915 = 1,145. Use this for S for 1916.

$E_1 = 29.5.$

$$S = \frac{210{,}000}{11 \times 29.5} = 645.$$

January 22 to February 1, the amount of steam metered was 172,000 lbs.

$E_1 = 25.7.$

$$S = \frac{172{,}000}{10 \times 25.7} = 665.$$

$$\frac{645 + 665}{2} = \text{Average S, } 655.$$

Consumption during period B = 665 × 12 × 22.5 = 177,000 lbs.

The total meter reading was increased 40,000 lbs. for the month, or 177,000 lbs.—137,000 lbs. and the consumer admitted the justice of our charge.

Chimneys: Their Design and Construction

2—Designing Data.

By HAROLD L. ALT.

For heating plants in larger buildings the design of the chimney approaches that of the stacks used for power plants and the quality of fuel is quite liable to be of more or less inferior grade. Under such conditions the height and area become of prime importance since upon the proper size and height of a chimney depend the satisfactory operation of the entire heating plant. It is the purpose of the balance of this article to deal with the numerous factors entering into the matter of sizing the chimneys in a practical manner and with the avoidance, as far as possible, of all the complicated calculations usually found involved in such design.

FRICTION LOSSES.

It must be understood that a chimney or stack filled with hot air or heated gases has a lower pressure at its base than the outside air, owing to the tendency of the heated gases to rise. Now this tendency to ascend is what is known as the "theoretical draft" and its calculation is comparatively simple; the trouble is that as soon as the gas actually commences to rise the element of friction comes into play, this friction being the result of the rubbing of the gases against the sides of the chimney and varying according to the weight of the gases and the velocity with which they pass along the surface. This friction also depends upon the length and quality of the surface passed over—otherwise the height of the chimney. For a given set of conditions this friction can also be computed and the "theoretical draft" less the "friction loss in the stack" will give the "available draft" at the base of the stack.

But this is not the only friction loss which must be overcome by the chimney "theoretical draft." The other losses consist of the friction of the air passing through the fire, all around the gas passages of the boiler, the resistance of the bends into the breeching, in passing along the breeching, and the bend into the chimney itself.

The total draft necessary (*i.e.*, "theoretical draft") must be equal to, or greater than, the sum of all the friction losses encountered by the air from the time it enters the ash pit until it leaves the top of the stack so that, besides the friction loss in the stack itself, other losses must be considered. Such losses are usually expressed in inches of water and are so treated in this discussion.

The first of these losses and one of the most variable encountered is the loss of draft in passing through the grates and fire bed. This varies with the fuel, its size, and the quantity it

is desired to burn per square foot of grate. This quantity per square foot of grate is in turn governed by the efficiency of the boiler, the horsepower of the boiler and the desired amount of overload to be provided.

In order to give the designer an idea of the various draft losses encountered and of the number of pounds of coal required for any set of conditions Tables III and IV have been prepared, Table III being the number of pounds of coal per hour for the development of various horsepowers at several rates (4 to 7 lbs.) of pounds of coal per boiler horsepower developed. In the right-hand column is shown the number of pounds of air per second necessary for the combustion of the required coal to produce this horsepower, the reason for rating this air in pounds per second being for greater facility in applying formulas to the chimney friction loss, as will be seen later. The number of cubic feet per pound of coal upon which these pounds of air are computed consist of 18 lbs. of air to every pound of coal or about 250 cu. ft. per pound which is a fair and average air consumption in the combustion of this fuel.

It should be noted that the H.P. readings in Table III are actual horsepower deveolped and *not* the rated horsepower of the boiler. Thus if a 200 H.P. boiler was expected to carry 50% overload its maximum developed horsepower would be $200 + 0.50 \times 200 = 300$ H.P. and this is the amount to be considered in the table.

Table IV is the draft loss encountered for various rates of combustion when applied to the commoner forms and sizes of anthracite and bituminous coal and represent average firing conditions. It is entirely possible to bank a fire so heavily with fuel that the draft loss is greatly increased or to keep the fuel bed so thin as to reduce the draft loss, thereby increasing the rate of combustion. Neither of these extremes is desirable, however, and Table IV represents average desirable firing conditions.

TABLE III.—REQUIRED POUNDS OF COAL AND AIR FOR HORSEPOWERS AT VARIOUS EFFICIENCIES.

TOTAL LBS. OF COAL	POUNDS OF COAL PER BOILER H. P. DEVELOPED							LBS. OF AIR PER SEC.
	4	4½	5	5½	6	6½	7	
			HORSE POWER DEVELOPED					
50	12	11	10	9	8	8	7	0.25
100	25	22	20	18	16	15	14	0.5
150	17	33	30	27	25	23	21	0.75
200	50	44	40	36	33	31	29	1.0
300	75	67	60	55	50	46	43	1.5
500	125	111	100	91	83	77	71	2.5
750	187	167	150	136	125	115	107	3.7
1,000	250	222	200	182	167	154	143	5.0
1,500	375	333	300	273	250	231	214	7.5
2,000	500	444	400	364	333	308	286	10.0
2,500	625	555	500	455	416	385	357	12.5
3,000	750	667	600	545	500	461	429	15.0
4,000	1,000	889	800	727	667	615	571	20.0
5,000	1,250	1,111	1,000	909	833	769	714	25
7,500	1,875	1,667	1,500	1,364	1,250	1,154	1,071	38
10,000	2,500	2,222	2,000	1,818	1,667	1,538	1,429	50
15,000	3,750	3,333	3,000	2,727	2,500	2,308	2,143	75
20,000	5,000	4,444	4,000	3,636	3,333	3,077	2,857	100
30,000	7,500	6,667	6,000	5,454	5,000	4,615	4,286	150
40,000	10,000	8,889	8,000	7,273	6,667	6,154	5,714	200
50,000	12,500	11,111	10,000	9,091	8,333	7,692	7,143	250
75,000	18,750	16,667	15,000	13,645	12,500	11,538	10,714	375
100,000	25,000	22,222	20,000	18,181	16,667	15,384	14,286	500
125,000	31,250	27,778	25,000	22,745	20,833	19,230	17,857	625
150,000	37,500	33,333	30,000	27,273	25,000	23,076	21,428	750
200,000	50,000	44,444	40,000	36,363	33,333	30,768	28,576	1,000
300,000	75,000	66,667	60,000	54,545	50,000	46,154	42,857	1,500
400,000	100,000	88,887	80,000	72,727	66,667	61,536	57,143	2,000
500,000		111,111	100,000	90,909	83,333	76,923	71,428	2,500
750,000				136,455	125,000	115,380	107,143	3,750
1,000,000							142,860	5,000

TABLE IV—DRAFT LOSS IN FIRE

(In. of water)

FUEL	POUNDS OF COAL PER SQUARE FOOT PER HOUR BURNED ON GRATES								
	5	10	15	20	25	30	35	40	45
Anthracite									
No. 3 Buck	0.15	0.40	0.75	1.24	...	...	...	...	...
No. 1 Buck	.10	.24	.44	0.68	1.00	...	...	...	...
Pea	.06	.16	.30	.45	0.65	0.90	1.20	...	...
Bituminous									
Semi bituminous	.05	.10	.18	.26	.35	.45	0.58	0.70	0.78
Penn. Ala. Ill. & Ind.	.04	.09	.15	.22	.28	.38	.45	.55	.60
Slack	.04	.07	.10	.15	.20	.27	.34	.40	.50
Run of Mine	.04	.05	.08	.10	.14	.16	.20	.25	.32
On Chain Grate	.05	.12	.15	.23	.31	.44	.57	.75	.94

Therefore if the total produced horsepower, pounds of coal per horsepower, number of pounds of coal per square foot of grate and the kind of fuel together with its size are either known quantities or can be assumed, a fair approximation of the draft loss through the fire under these conditions can be readily determined.

Under normal conditions and efficiency it is usual to assume about 5 lbs. of coal per horsepower developed.

OTHER FRICTION LOSSES.

The next loss to be considered is that resulting from the gases passing around the various baffles and through the paths of travel maintained in the different types of boilers. Actual experiment has shown that this draft loss in water-tube boilers seldom exceeds 0.25 in. when a boiler is developing full rating; 0.40 in. when run at 50% overload; and 0.70 in. when operating at 100% overload. In horizontal return tubular boilers the loss is about 0.2, 0.3, and 0.45 in., respectively, while in vertical boilers it runs 0.1, 0.15, and 0.2 in. only. Owing to the fact that heating boilers are seldom if ever figured at being run upon any overload capacity it may be assumed that 0.25 to 0.30 in. wall cover any draft loss which the ordinary heating engineer will be required to consider. Economizers have a draft loss of about 0.3 in.

The losses resultant from the gases passing around bends after leaving the boiler are considerable and, therefore, the easier the bends of the breeching are made and the slower the velocity of the gases, the smaller will be the loss. The 90° change of direction usually made by by the gases in passing from the boiler uptake into the horizontal flue and the 90° horizontal bend from the horizontal flue into the stack and the 90° change from the horizontal direction to the vertical direction in the stack itself all count against the draft and result in the certain loss. It has been found by experiment that in steel flues the loss for each right angle turn is approximately 0.05 in. and that the loss for the straight round or square flue itself due to the friction of the gases along the sides, tops and bottom is about 0.1 in. per 100 lin. ft., while in concrete flues the losses for bends of 90° are 0.1 in. and, for straight flues of 100 ft. length 0.2 inches. So that the total loss of draft say for 150 ft. of steel flue and five right angle bends between the boiler uptake and the stack, including the change of direction into the stack, will be $0.1 \times 150/100 + 0.05$ in. $\times 5$, or $0.15 + 0.25$, or 0.4 in. Having obtained all the draft friction losses up to the point where the gases enter the base of the stack it only remains to compute the friction in the stack in order to obtain the total of all friction losses.

The friction loss in the stack, however, is extremely variable in this way. For a given number of pounds of air per second passing up a stack the velocity will, of course, vary as the diameter is increased or decreased, the smaller diameter resulting in a higher velocity and a greater friction loss, and the larger diameter giving a lower velocity and a smaller friction loss. From this it is readily seen that there is a relation between the height and the diameter, one being to a more or less extent dependent upon the other. Thus, if a stack of a

given height and 3 ft. in diameter has a theoretical draft of 1 in. its friction loss could also be 1 in. provided that the weight of gas to be handled were of sufficient quantity; therefore, the available draft (which has previously been shown as equal to the difference between the "theoretical draft" in the chimney and its "friction loss") would be in this case 1 in. — 1 in., or zero, so that there would be practically no pull at the base of the chimney, provided that the gas up to the quantity required were supplied from some other source. However, if the stack diameter were increased to 4 ft. the velocity would be correspondingly lessened, resulting in a falling off of the friction loss perhaps to 0.5 in., leaving 0.5 available at the bottom to overcome the other draft losses; increasing the diameter again would result in a still smaller friction loss and a still higher available draft at the base of the chimney. But how far should the increasing of the diameter be carried?

TWO METHODS OF PRODUCING DRAFT.

It must be understood that the draft can be produced in two ways. On the first chimney the "friction loss" equaling the "theoretical draft," an increase in the height would only result in a proportional increase in the "theoretical draft" and the "friction loss." Since these amounts are equal, the proportional increases will be equal and the results would be equal. On the second chimney, however, if the height were increased 50% the "theoretical draft" would be increased 50% and the "friction loss" increased 50%, resulting in the "available draft" being also increased 50% so that on the 4 ft. stack an increase could be secured for the "available draft" either by increasing the height, or increasing the diameter (using the same height), or by a combination of both. Thus it can be seen that several chimneys of varying diameters in height can be constructed, each of which would give the same "available draft" at the base when handling the same amount of gases, with all other conditions equal, it only being necessary to increase the height sufficiently to make up for the added friction when the diameter is reduced or, conversely, to increase the diameter so as to reduce the friction as the height is decreased and the "theoretical draft" therefore weakened.

DRAFT LOSSES MUST BE EQUALLED BY "THEORETICAL DRAFT."

But there is one point upon which no mistake should be made and that is that the draft losses in the fire, boiler, breeching, bends, and stack must be equalled or exceeded by the "theoretical draft" and no enlargement of a stack which is of insufficient height can ever make up for a "theoretical draft" which is less than the friction losses between the ash pit and the base of the chimney, since the chimney friction must always be *added* to these and it is not possible to produce a chimney large enough so that its friction loss will be *zero*. Therefore, a certain *height* of stack *must* be used to meet given conditions of draft loss and no increase of diameter will allow a stack of *less* height to be used.

THE QUESTION OF HEIGHT AND DIAMETER.

This brings up the point of whether it is cheaper to build a stack higher than absolutely necessary using a smaller diameter, or to build it only as high as it is absolutely necessary to meet the intensity of draft requirements and to increase the diameter accordingly. In answer to this it may be said that, where conditions permit, a stack is most economically built when made only of the height absolutely required to produce the required intensity of "available draft" and when built large enough to take care of the amount of gases to be handled with only a reasonable loss for friction. There *are* cases in high buildings where stacks must be carried up a certain distance in order to get above the roof of the building and in these instances there is no option but to use the height of stack necessary, at the same time cutting down the diameter so that the stack friction will build up a draft resistance which will counter-balance the excess of intensity and still produce the proper and desired "available draft" result in the boiler room.

REASONABLE FRICTION LOSS IN A STACK.

What, then, shall be considered as a reasonable friction loss in a stack? Experience has shown that stacks built of a sufficient diameter, so that their losses by friction amount to about 0.2 in. per 100 ft. of height, give good results and economical design. With this assumption it is now easy to compute the total draft loss for any given installation since the loss in the fire, the boiler flues, the breeching, the elbows and the stack are either known or their proper limits assumed. This total friction loss must be counter-balanced by the "theoretical draft" produced by the chimney; thus, if the sum of all the resistances equals 1 in. of water, the "theoretical draft" produced by the chimney must equal or exceed 1 in. of water in order to produce the desired results.

The "theoretical draft," as before defined, is the tendency of the heated gases in the chimney to rise without regard to the "chimney friction" and an actual reading on a draft gauge placed at the bottom of a chimney, with all inlets into the chimney closed tight and the entire contents of the chimney gases heated to the desired degree, would give this same reading provided the chimney were air tight and had absolutely no leakage. The exact force of this "theoretical draft" depends upon two things—namely, the weight of the air outside of the chimney and the weight of the gas inside. These in turn are controlled entirely by temperature and altitude.

In the ordinary heating installation, such as for residence work, the average temperature of the chimney gases is generally about 250° F. Such cases have already been considered in the first part of this discussion and are not the ones which give the most serious trouble, this section being particularly designed to cover the larger plants operating usually with steel boilers. Where cast-iron boilers are used this method will also apply if the proper draft loss for the particular type of boiler to be used is obtained from the manufacturer and substituted for the steel boiler losses given. In such installations, when run at their maximum load (*i.e.*, on a zero day) the average stack temperature will be close to 500° F. Moreover, as this occurs only in zero weather, the heating system is helped out by having the greatest temperature difference occur on the days of maximum load. The formula to compute the "theoretical draft" is

$$TD = 0.52\ H \times P\ (1/t - 1/T)$$

When TD is "theoretical draft"
H the height of the chimney in feet.
P the absolute air pressure in pounds per square inch.
T the absolute temperature of the stack gases.
t the absolute temperature of the outside air.
and 0.52 a constant.

It will be noted that this formula takes no account of the difference in densities between the gases in the stacks and the outside air, but this difference is small and the error is entirely on the side of safety. Besides this, the volatile gases from the coal will slightly increase the weight of the air assumed (although this increase will be less than 5%) and thus counterbalance, to a large extent, the difference resulting from a variation in the densities.

Fig. 5 shows the theoretical drafts produced by chimneys up to 250 ft. in height when set at various elevations from sea level up to 10,000 ft.

To find the draft loss in a stack handling any given weight of gas per second the formula is

$$L \text{ equals } \frac{fG^2CH}{A^3} \text{ in which}$$

L is draft loss in chimney in inches of water.

G the weight of gas handled in pounds per second.

C the circumference, H, the height and A the area of the chimney, all in feet.

f equals a constant, being 0.0019 for brick chimneys and 0.0014 for unlined steel stacks with flue gases at 500° F. average temperature.

Fig. 6 shows the results of this formula when computed for brick stacks or lined steel stacks 100 ft. high with the gases at 500° while Fig. 7 indicates similar curves for unlined steel stacks. In these curves the weight of gas handled is indicated in the left-hand column and

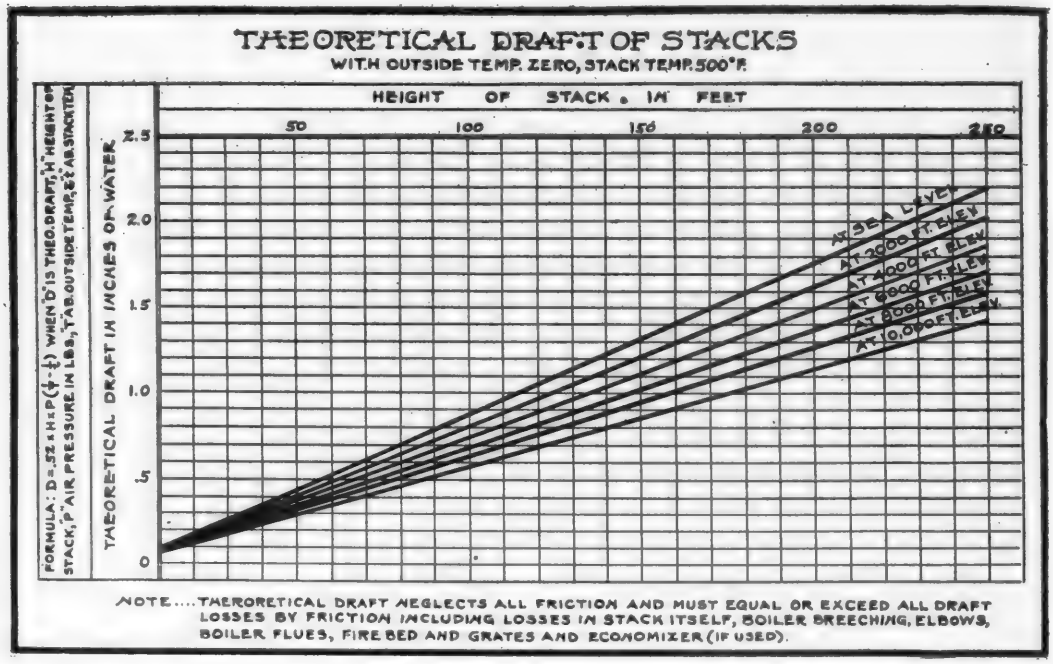

THEORETICAL DRAFT OF STACKS
WITH OUTSIDE TEMP. ZERO, STACK TEMP. 500°F.
HEIGHT OF STACK IN FEET
50
100
150
200
250
THEORETICAL DRAFT IN INCHES OF WATER
2.5
2.0
1.5
1.0
.5
0
AT SEA LEVEL
AT 2000 FT. ELEV.
AT 4000 FT. ELEV.
AT 6000 FT. ELEV.
AT 8000 FT. ELEV.
AT 10,000 FT. ELEV.
FORMULA: D=.52×H×P(1/T−1/t) WHEN D IS THEO. DRAFT, H HEIGHT OF STACK, P AIR PRESSURE IN LBS., T ABS. OUTSIDE TEMP., t ABS. STACK TEMP.
NOTE....THEORETICAL DRAFT NEGLECTS ALL FRICTION AND MUST EQUAL OR EXCEED ALL DRAFT LOSSES BY FRICTION INCLUDING LOSSES IN STACK ITSELF, BOILER BREECHING, ELBOWS, BOILER FLUES, FIRE BED AND GRATES AND ECONOMIZER (IF USED).

FIG. 5—THEORETICAL DRAFTS PRODUCED BY CHIMNEYS UP TO 250 FT IN HEIGHT.

the friction in inches of water is read along the top of the chart. The curves indicate the diameters of the stacks and the arrows indicate the point where the friction loss becomes 0.20 in. It must be remembered that these charts represent losses for 100-ft. stacks and that the loss for any other height can be obtained by multiplying by the desired height and then pointing off two places.

For stacks at sea level the above information is sufficient, but stacks at higher elevations must have their diameters increased as shown by the percentage in the right-hand column in Table V. The volume—owing to the lower atmospheric pressure—is increased at higher elevations, as shown in Table V, the volume at sea level being taken as a base. This shows that a correction factor is necessary for stacks at higher elevations. The additional height for any elevation can be obtained from the "theoretical draft" chart (Fig. 1), but the diameter must be increased until the enlarged *area* exceeds the original area computed by the *same* percentage, as the volume of the air at the given elevation exceeds that at sea level. Thus, at 10,000 ft. above sea level, the volume of the air per pound being 51% greater, the area of the stack (not the diameter) should be enlarged 51% in order to maintain the same velocity as would be experienced under similar conditions at sea level.

For example, suppose a steel stack, lined, at sea level is to be designed to serve

Six—250 H.P. boilers with four of

TABLE V—FACTORS OF AIR AT VARIOUS ELEVATIONS

ELEVATIONS FT. ABOVE SEA LEVEL	AIR PRESSURE LBS. PER SQ. IN.	CUBIC FEET PER LB.	INCREASE IN VOLUME %
0	14.7	13.33	0.000
1,000	14.2	13.80	0.034
2,000	13.7	14.31	0.073
3,000	13.2	14.84	0.113
4,000	12.7	15.43	0.158
5,000	12.2	16.07	0.203
6,000	11.7	16.75	0.257
8,000	10.7	18.31	0.373
10,000	9.7	20.20	0.514

them in service at 50% overload in extreme weather or six in service at normal rating.

. Coal to be burned, bituminous run of mine;

Breeching, steel, 75 ft. long—square—
Turns, one—90° up from boiler,
one—90° into the breeching,
one—90° towards stack and
one—90° up into stack.

Turning to Table III and assuming 5 lbs. of coal per horsepower it is found in the columns under the heading "Pounds of Coal per Boiler H.P." and in the column under the heading "5" that 1,500 B.H.P. will require 7,500 lbs. of coal per hour (in the extreme left-hand column) and that the "Pounds of Air per Second" (in the extreme right-hand column) is 38.

If each boiler has 80 sq. ft. of grate surface, with six boilers in service, the total grate surface would be 6 × 80 sq. ft., or 480 sq. ft., but with only four in service the total grate surface would be only 4 × 80 sq. ft., or 320 sq. ft.

7,500 lbs. of coal/320 = 24 lbs. per sq. ft. at 150% rating.

7,500 lbs. of coal/480 = 16 lbs. per sq. ft. at 100% rating.

In Table IV it is found that the fire loss for run of mine bituminous coal at 24 lbs. per square foot is 0.14 in. and, for 16 lbs. per square foot, 0.08 in. and

The boiler loss may be assumed at 0.25 in. at full rating or 0.40 in. at 150%.

Smoke breeching loss totals:

0.1 × 75/100 = 0.075 for straight pipe

Four bends @ 0.05 = 0.20 for bends, or 0.28 in. total for bends and breeching.

Assumed for stack 0.2 in. per 100 ft. of height

The total draft loss is then equal at

	100% Rating, Inches Water	150% Rating Inches Water
Fire	0.08	0.14
Boiler	0.25	0.40
Breeching	0.28	0.28
Stack	0.20	0.20
Contingencies	0.10	0.10
	0.91	1.12

From Fig. 5 the curve at sea level shows that the stack (for 100% rating) must be about 103 ft. high, increasing its friction loss to 0.2 in. × 103/100 = 0.21 in. making 0.92 total, requiring possibly 103 ft. actual height. As the

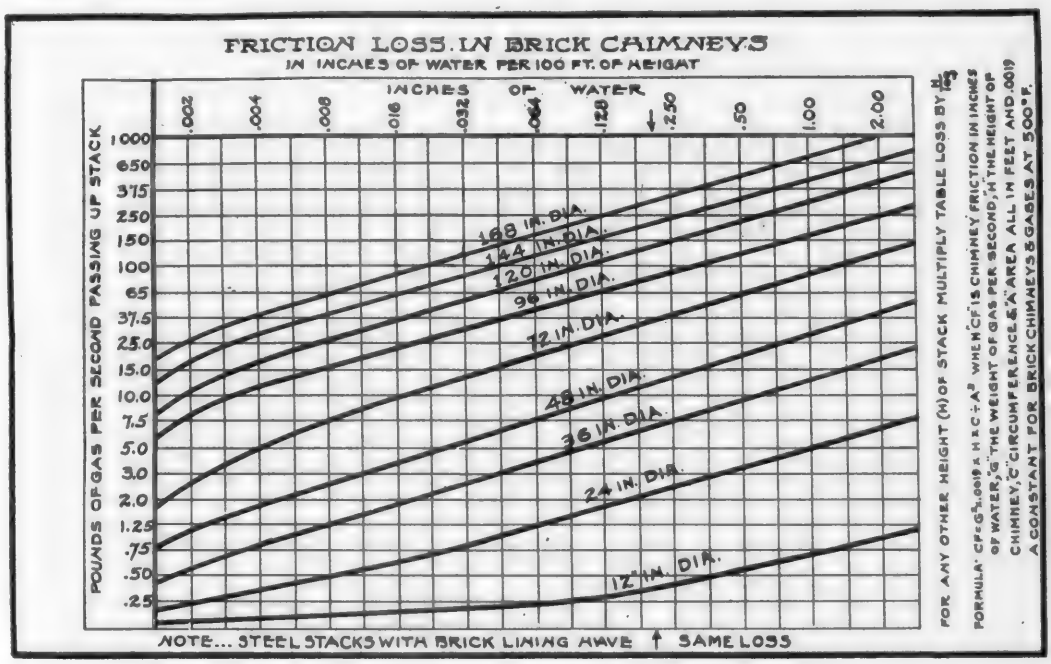


FIG. 6—DRAFT LOSSES IN BRICK STACKS OR LINED STEEL STACKS 100 FT. HIGH.

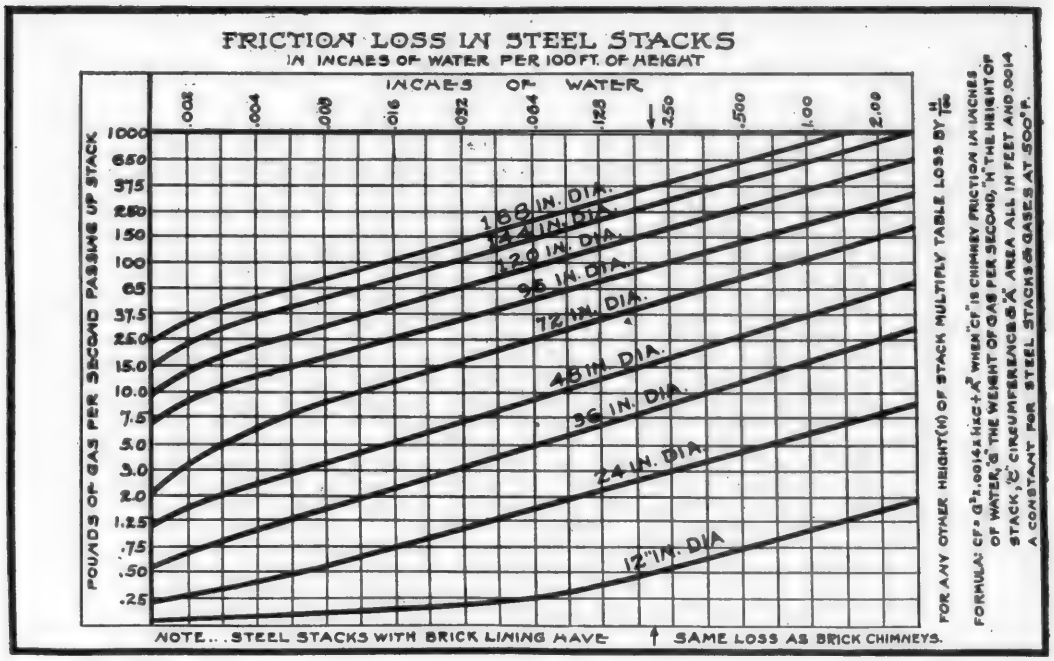


FIG. 7—DRAFT LOSSES IN UNLINED STEEL STACKS 100 FT. HIGH.

stack is lined the friction loss will be the same as a brick chimney and in Fig. 6 the point under the arrow and opposite 38 lbs. of air per second is found to be almost on the 72 in. line, this diameter of stack being correct for the 100% rating.

For 150% rating by similar procedure the required height of stack is found in Fig. 5 to be 127 ft. and the friction loss will be $0.2 \times 127/100 = 0.25$ or 1.17 in., total, or about 130 ft. height required, Since under these conditions the chimney friction loss is 0.25 in. by referring to Fig. 6—opposite 38 lbs. of air per second and under 0.25 in. loss, the intersection falls on 72 in. diameter exactly. This shows that the diameter is the same in each case because, of course, the quantity of gas is the same, but the height must be increased when forcing the four boilers to 150% of their ratings.

Now suppose this stack was to be located at a point 5,000 ft. above sea level. Then the theoretical draft must be 1.12 in. as before, but, referring to Fig. 5, it is found that for 5,000 ft. requires a stack 158 ft. high. The friction loss is then $0.2 \times 158/100 = 0.31$ in. and this will increase the total friction by 0.31 — 0.2, or 0.11 in., making $1.12 + 0.11 = 1.23$ in. This applied to Fig. 5 shows a stack actually required 172 ft. in height.

Then with a stack friction of 0.31 in. of water, in Fig. 6 under 0.31 in. and opposite 38 lbs. of gas per second is found a point close to the 72 in. diameter line. Reference to Table V shows that the volume at 5,000 ft. is increased 20%. The area of a 72-in. stack is about 28 sq. ft. which, increased by 20%, is $28 + 28 \times 0.2$,, or 33 sq. ft., or about a 78-in. stack.

To summarize—Add all friction losses together (fire, boiler, breeching, turns, etc.) allow 0.2 in. for stack friction and obtain total theoretical draft. Read height of stack for these losses from Fig. 5 and modify stack loss of 0.2 in. to suit height of stack found. Re-read new and final height from this modified figure. Read diameter for volume of gas per second and height found from Figs. 6 and 7. If stack is above sea level read height from proper curve in Fig. 5 and increase area according to Table V.

CHIMNEY COSTS.

As far as the cost of chimneys is concerned this is a rather variable amount and depends on the material of construction, the foundation necessary, loca-

tion of job, etc. The ordinary materials of construction are common red brick, radial brick, steel and concrete. Steel stacks are divided into lined and unlined or partially lined and also into self supporting and guyed stacks. Steel is the most unstable of the materials mentioned, these stacks lasting 10 to 12 years and requiring frequent painting; they rust rapidly when not in service. Lined steel stacks have a lining of fire brick to protect them from the action and heat of the gases contained.

Brick stacks last a long time, while concrete is practically indestructible if properly erected. Radial brick chimneys are built of special radial brick which have five or six holes about 1 in. in diameter running through them vertically.

The cost of radial brick chimneys per horsepower will run about as follows for the maximum horsepower which they will handle:

Up to 100 ft. high 4 ft. to 6 ft. dia., $2.50 to $4.50 per H.P.

Up to 125 ft. high 6 ft. to 12 ft. dia., $2.30 to $3.75 per H.P.

Up to 150 ft. high 8 ft. to 14 ft. dia., $1.75 to $2.75 per H.P.

Up to 175 ft. high 10 ft. to 14 ft. dia., $1.75 to $2.00 per H.P.

Up to 200 ft. high 12 ft. or over dia., $2.00 per H.P.

If the cost of a radial brick stack be taken as unity the comparative costs of other constructions will vary about as follows:

	Cost per Horsepower
Radial Brick	1.00
Common Red Brick	1.25
Steel—self supporting—lined	1.23
Steel—self supporting—partially lined	1.14
Steel—self supporting—unlined	.86
Steel—guyed, lined	1.00
Steel—guyed, partially lined	.80
Steel—guyed, unlined	.60

This same method of sizing stacks may also be used for power boilers if properly modified. For instance, maximum power loads may and will come when the temperature is 90° F., instead of zero; therefore theoretical draft must be computed with allowance for this condition. The writer knows that 62° F. is the common outside temperature assumed in calculations for power chimneys, but why? What will be done with a maximum load on a hot day—say at 90°?

Economizers if used will not only build up the friction loss about 0.3 in. in addition to all other losses, but will also cool the stack gases down to 250° to 300°. This must also be allowed for in computing theoretical draft.

When stokers are used with forced draft all fire losses may be eliminated, as in this case the duty of the chimney will extend only so far as to pull the gases off from over the fire bed. It is best, however, to figure about 0.1 in. over the fire to prevent back drafts when the firing doors are opened and the forced draft may be blowing through some open spots in the fire.

A Study of Ventilation with Screened Windows.

Supt. Wm. G. Cleaver of Bethlehem, Pa., in his annual report to the board, has given a brief summary of a study of ventilation by the gravity method and by the use of cloth window screens. The study covered a period of five months, from November to April, and was limited to six rooms distributed among three buildings. In each of the buildings one of the rooms was equipped with cloth screens and the other, of the same grade, with the usual means of ventilation.

In making the study, careful records were kept covering temperature, nutrition as shown by weight, health as denoted by absences due to minor ills, resistance to diseases of graver character, and mental condition as indicated by results of a series of speed tests designed to reveal fatigue. The results bear out the following conclusions:

Temperature—No trouble was experienced in maintaining the temperature of all the rooms at approximately 70° F.

Ventilation and Atmosphere—The air did not recirculate as freely in the rooms with screened windows as in those ventilated in the usual manner. During the latter part of the school sessions the air in the first-named rooms became unpleasant and oppressive.

In general, the conclusion is reached that the method of ventilating with cloth screens does not possess advantages which justify its general use.—From the *American School Board Journal.*

The Importance of Personal Supervision for Heating Departments of Utility Companies

Why a Heating Superintendent is Essential in Effecting Economies and Increasing the Revenue.

By R. V. STUREMAN,
Superintendent Heating Department, Springfield (Ill.) Gas & Electric Company.

The central station heating business is comparatively new and is passing through the same development stage that the electric business passed through a few years ago. It has been looked upon as an incidental side issue or a necessary evil in connection with the electric department. For this and various other reasons it has not always been intelligently handled in the past. It is very gratifying to see that this condition is changing—that the managers and executives of utility companies are beginning to realize that the district heating business can be made a profitable one.

HEATING DEPARTMENT SHOULD HAVE ITS OWN SUPERINTENDENT.

Several things are necessary before a heating company can be put on a paying basis. Among these are the personal superintendence and management by one who is interested solely in his own department. So many companies in the past have felt that the heating department could take care of itself and, in the majority of cases, the superintendent of the gas or electric department has had supervision over it. In these cases the superintendent was generally more interested in the larger department and the heating department suffered by receiving practically no attention whatever.

It is high time for those companies which are not at present operating on a profitable basis to meet the conditions squarely and overcome the difficulties in the best way suited to the existing conditions. This would include the adoption of a proper meter rate and the assumption of the burden of education of the consumer by the company to eliminate unnecessary use of steam and the supervision of the consumer's installation to insure his getting a proper system and one which will permit him to get the best service at the least cost, including the practicable convenience for the company to furnish the service. This latter will influence the cost of service by the company and, on that account, the rates to be charged, which in turn have a direct bearing upon the total cost of heat to the consumer.

The supervision of the consumer's piping and heating system is necessary on account of the fact that so many systems are put in by pipe fitters who are pipe fitters only and have not realized their responsibility or intelligently studied or worked out the possibilities of the problem.

To perform this work of supervision of installation and the education of the consumer along the lines of regulation, will require an expert especially trained in the operation of a central station heating plant and one who can devote his entire time and closely associate himself with the people and cope with all the different problems which may arise. He should have absolute supervision of his department from the time the service leaves the station until the bills for service are paid by the consumer.

TYPICAL RESULTS OF CO-OPERATION WITH CONSUMERS.

The importance of the company's cooperating with its customers in the regulation of their service is most forcibly brought out by the recent attempts of two heating companies to change all customers from flat to a straight meter rate. The companies will be referred to by the letters "A" and "B."

During the year 1911, the gas, electric and heating business in the town A was purchased by a well-known utility company. This town has a population of about 10,000 and was similar to other small-town, locally-owned-and-operated plants. Everything was on a flat rate basis and the rate was away below any

proper flat rate. The method used to determine what the rates should be on a building was to charge a few dollars in excess of what the coal bill has been before. It can readily be seen that the operation was very careless and that the customers had no thoughts regarding the proper use of steam, the majority hardly knowing that it was possible to shut off the steam supply in their building. During the first year of the new management, the rates were allowed to remain the same.

At the beginning of this year a man was put in charge of the department and every conceivable record was compiled regarding the heating system and consumer's premises. At the end of the season it was decided to adopt a meter rate and cancel all the flat rate contracts. A report was compiled showing what each consumer had paid and showing what they probably might pay under the new meter rate. These figures were placed before each customer and considerable time was spent in talking to them about the use of steam and how they could eliminate the waste which would be so much to their and the company's benefit. This talk and figures gave them an opportunity to know in advance just what they might expect during the coming season. If their flat rate had been exceptionally low and with the best of regulation it would be impossible for them to keep down to that amount, they were told. If they were not satisfied they could discontinue the service if they so desired. They appreciated this frankness on the part of the company and, as a result, out of ninety customers only two refused to sign.

EFFECT AFTER METERS WERE INSTALLED.

During the heating season the operation of the meters was watched very closely by a capable meter man and a record was kept of the consumption for each consumer by weeks. Each week the condensation per square foot of radiation was computed and if the consumption seemed to be excessive, a personal visit was paid the customer by the superintendent and all the conditions existing in connection with his building were carefully analyzed in an effort to find where the excess steam was being used. If the steam was actually being wasted, the consumers were shown so that the waste might be eliminated. In several cases the service piping was found to be trapped and service condensation was being carried over into the customer's meters. In these cases the service was immediately changed. The superintendent kept in touch with all the consumers, talking regulation continually and endeavoring to give them the best service possible. The season ended wonderfully successful, as the comapny's revenues were increased and the station send out materially decreased. The feeling of the people was pleasant and, while several had had their season's bill increased, they appreciated the co-operation they had received from the company. Some were able to see where they could reduce still further the next year, while others realized that under the old basis of charging they had been paying less than they should and were willing to pay the increase because the service received had been so much improved.

Now this pioneer work in education was absolutely necessary. In this town it has been brought up to standard and is now self-sustaining and almost unnecessary. Anyone starting out anew with meter rate has only to be told the mere principles of regulation and he will instinctively save, but it naturally requires considerable thought for anyone to do this who has been on a flat rate for years, using all the steam possible for twenty-four hours a day throughout the entire season.

RESULTS OF CHANGE TO METERS WHERE CONSUMERS WERE NOT CONSULTED.

The results of lack of co-operation is seen in the situation that the town B is facing at present. Town B is very similar to Town A and the size of the systems are practically the same. This plant has been operated on the old basis of rates based on amounts of radiation which, in most cases, had no connection whatever with the building. The heating department in this place was under the supervision of the electric department superintendent.

Last summer it was decided to make the change from flat to meter rate. An outside engineer was called in and data were compiled on the consumer's radiation and a report was made up showing what each had paid and what amount probably would be paid on a meter rate. This report was then turned over to the local men in charge and it was left to them to conduct the work of making the change. Nothing was said to the consumers, but the general impression and idea was given out to all that a meter rate was even cheaper than the flat rates they had been paying which, in most cases, were ridiculously low. Meters were set and steam turned on in the fall. The people had always used steam continuously and they continued to do so. The only difference between meter rate and flat rate to them, as far as steam was concerned, was a different method of computing their bill which should now be less and that they could still use as much steam as ever before.

It was not possible to get all the meters set before the steam was turned on so most of the first month's bills were on the old flat-rate basis. The second month, however, passed by and the meter bills were enormous—in some cases double and even triple the old flat-rate. A strenuous complaint was made regarding the high bills, together with a few complaints as to service. Previously a Paul air-line system had been operated with the pump at the plant. This increased the circulation in the system, giving good service for those systems which were not properly installed. After the change in rate this air line was abandoned, which resulted in poor service for those customers. With a small amount of investigation and expense these troubles could largely have been remedied, greatly to the people's satisfaction, which would have recompensed them in part for the increase in their bills. Nothing was done and the third month went by. The bills this time were still higher. Some in these three months had paid more than before in an entire season. Headed by an attorney eager for a following and prominence, a complaint was filed with the State Public Utilities Commission and a rate case is now in progress which is being a tremendous expense to the company.

EXPENSE OF A HEATING SUPERINTENDENT MORE THAN MADE UP BY ECONOMIES EFFECTED.

On first thought the expense of a superintendent for the heating department might seem prohibitive to many small companies but I will cite the experience of a large holding company owning and operating electric, gas, railway and heating properties in several States. Eight of the plants maintain heating systems, which range in size from 900,000 sq. ft. to about 50,000 sq. ft. of radiation connected.

Four years ago only one of these plants had a superintendent for the heating department. All of the plants but this were a losing proposition. From the results being obtained in this city it was decided to install a heating expert to have general supervision of all the heating departments of the various properties. The man chosen for this position was the one who had been superintendent of the above mentioned plant. During the past four years under his direction a superintendent has been placed in charge of the heating departments of each company and instead of the expense being higher, in each and every case there has been a material decrease by their personal supervision and the revenue has increased.

The record of one plant in particular is worthy of mention. During the spring of 1916 a man was put in charge of the heating department whose sole duty was the management of that department. During the past year he has made a saving in the operating expense and the revenue has increased over $8,000.00. One of the main reasons for the increase in revenue is the complete repairing and testing of the condensation meters. Also, previously, the registration of the meters were not given much attention. A consumer's bill was adjusted on the basis of the same month's bill in a previous year, the company not analyzing the steam consumption nor making any effort to receive payment for the amount of steam used if it seemed at all excessive.

All of these companies now possess a complete system of records from which it is possible to know definitely just how the plant is operating. The financial condition of these plants is changing so that the prospect is exceedingly bright for them to soon become profit-making concerns, rather than losing ones.

To my mind the importance of personal supervision for heating departments is of paramount importance above any other single item in the successful operation of a central station heating company.

The Transmission of Steam in a Central Heating System

How Extra "Feeder" Lines From the Boiler Plant Were Used to Solve the Problem of Overload.

By J. H. WALKER.

(*Presented at the annual meeting of the American Society of Heating and Ventilating Engineers, in New York, January* 16-18, 1917.)

The central heating situation in Detroit is, in many respects, unique. The rapid development of the business district and the popularity of the heating service have resulted in the extension of the distribution system over a very wide area, and the connecting of new buildings has made the street pipe system entirely inadequate for the transmission of the quantities of steam now required.

The problem thus arising has been met by treating the general network of pipes as distributing mains, and resorting to the use of "feeder" lines which extend from the boiler plants to the centers of load and which are used solely for transmitting steam to the distribution mains proper, no consumers being served from these feeders. The method which has been developed is parallel to that used in electrical distribution, where feeders radiating from the generating station carry current, with a large voltage drop, to various points in the net-work of mains. In the working out of this method, much attention has been given, perforce, to the matter of transmitting large quantities of steam over long distances in an economical manner.

DETERMINING MOST ECONOMICAL PIPE SIZES.

The problem is essentially one of choosing the pipe sizes so as to keep the investment costs and radiation loss at a minimum. There are four factors entering into the selection of pipe sizes: *a.* the amount of steam flowing; *b.* the length of the pipe; *c.* the pressure drop, and *d.* the size of the pipe. The first two quantities are fixed by the given conditions. Since the size of the pipe governs the investment required, it is desirable to use a small pipe and allow a large pressure drop when exhaust steam is used, the available pressure drop is the difference between the back pressure allowable on the electric generating units and the minimum pressure required at the end of the line. The difference is usually quite small and the resulting pipe sizes are consequently comparatively large; although it is now possible to buy turbines which will carry their rated load at a back pressure of 25 lbs., allowing the use of much smaller pipes. The use of bleeder type turbines also permits higher pressures on the steam lines at the plant, with a consequently larger available pressure drop.

In most central heating systems some live steam is used, either to augment the available exhaust during the coldest weather or to supply the system entirely. In feeding live steam directly to the system, the conditions are quite different. The upper limit of the pressure gradient which can be established in the line is then the boiler pressure of the plant, and under maximum load conditions the

full drop from boiler pressure to distribution pressure may be made to take place in the steam line instead of in a reducing valve. The diameter of the pipe which is required under these conditions is relatively very small. It is only recently that the full possibilities in this direction seem to have been realized and put into practice.

Suppose, for example, that it is desired to transmit 12,000 lbs. of steam per hour over a distance of 1,000 ft., with a terminal pressure of 10 lbs. If the pressure were reduced at the plant and the pipe designed for the ordinary velocities of 8,000 to 10,000 ft. per minute, an 8-in. pipe would be required. If, however, the usual standard of velocity is disregarded and the full available pressure drop from boiler pressure (assumed as 125 lbs.) to 10 lbs. is allowed in the pipe line, a 4-in. pipe would be sufficient. The cost of an 8-in. underground pipe 1,000 ft. long would be about $6,000.00. The cost of a 4-in. pipe of the same length would be about $4,000.00, 33 1-3% less. The heat loss per square foot of pipe surface would be greater in the case of the small pipe because of the higher average temperature of the steam in the pipe, but because of the less surface of the small pipe, the total heat loss would be less. It should be borne in mind, however, that in nearly all cases the heat loss is a small factor compared with the investment charges.

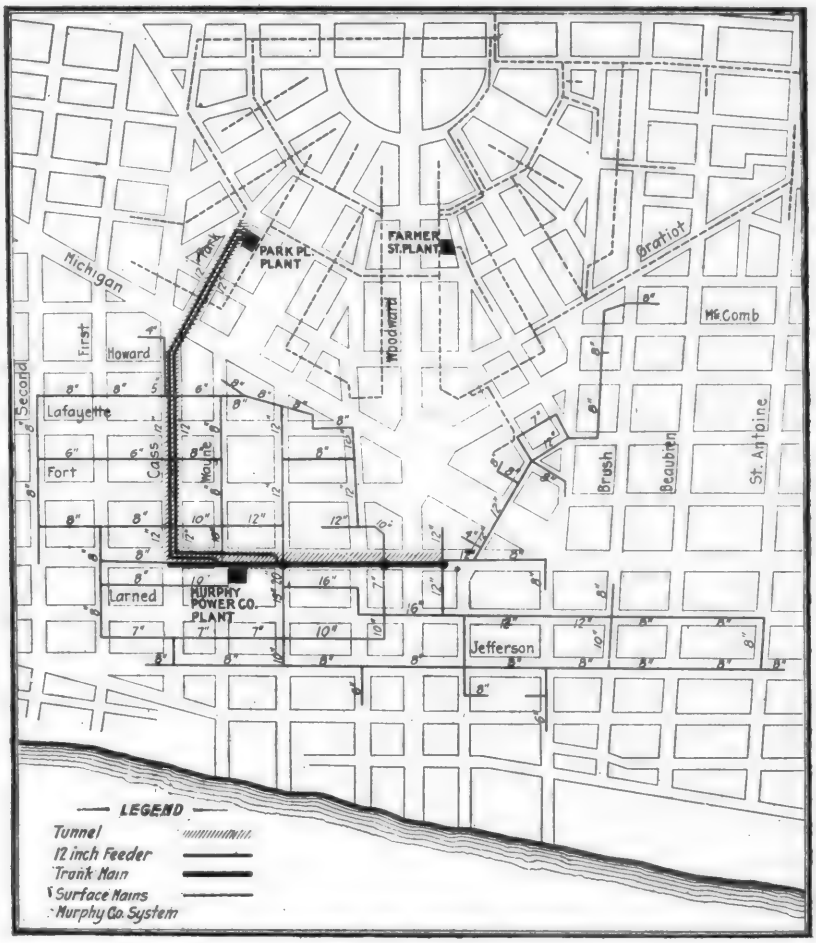


FIG. I—TRUNK MAIN AND FEEDERS TO MURPHY POWER COMPANY HEATING SYSTEM, DETROIT.

PRESSURE REDUCTION NECESSARY ON DISTRIBUTING MAINS.

In most of the existing central heating systems, it is impracticable to carry

pressures approaching boiler pressure on the distribution mains. Even if the underground construction is not of the low-pressure type, considerations of safety would require elaborate pressure reduction equipment in the consumers' buildings. Therefore, when the maximum allowable distribution pressure has been reached on the mains, where they are fed only at the plant, it becomes advisable to run out from the plant "feeders" of small diameter, carrying steam at high velocities, and with large pressure drops, to remote points in the distribution system. The pressure of the steam delivered to these feeders can be varied as the load requires, in order to maintain a constant pressure at the point where they tie into the distribution system. Such live steam feeders can also be advantageously applied to exhaust steam systems in which the limit of back pressure has been reached. Where this condition exists, the available exhaust is usually inadequate in extreme weather, and such live steam as is added should be fed into the system at some distant point through a high velocity feeder instead of being fed in at the plant and thereby further raising the back pressure on the engines. A third case in which such feeders can be used occurs when local conditions require that the boiler plant be located at some distance from the center of the load. Some interesting examples of this method of transmitting live steam have recently been worked out in Detroit, where the central heating system is operated by The Detroit Edison Company.

TYPICAL INSTALLATIONS OF "FEEDER" LINES.

In 1914, the heating system of the Murphy Power Company, serving about 500,000 sq. ft. of radiation in the business district, was taken over by the Edison Company. Since the Murphy Company's boiler plant was not taken over with the system, it became necessary to feed the system from the Park Place plant of the Edison Company, located about 2,000 ft. away. This plant supplies live steam to the Edison Company's heating system, and the addition of new boilers rendered it capable of handling the increased load.

At this time it was found advisable to replace the trunk distributing main of the Murphy system with a new main, and a new tunnel was constructed directly beneath the old, and about 45 ft. below grade, in which was installed a new 20-in. trunk main with 18-in. risers connecting with the surface mains. From the Park Place plant, a connecting tunnel was constructed, in which were installed two 12-in. "feeders," tying into the trunk main at the two chief centers of distribution, as shown in Fig. 1. Fig. 2 is a cross-section of the tunnel containing the trunk main, the two feeders, a condensation return line, and a high-pressure main which supplies steam for cooking and laundry purposes. This trunk tunnel is 8 ft. high and 8 ft. wide, and the feeder tunnel is 6 ft. high and 6 ft. wide. Both are built of three rings of brick, with concrete floors.

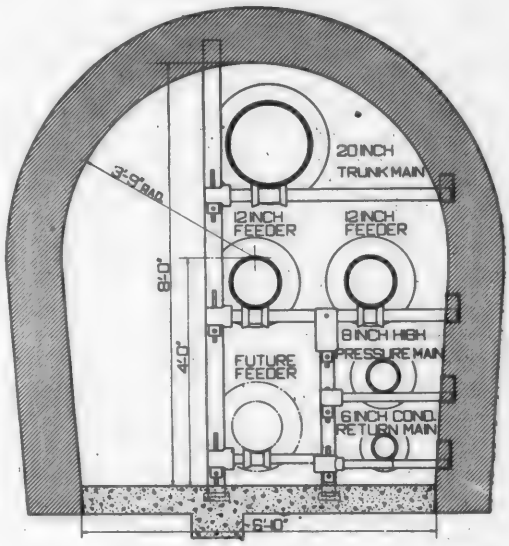


FIG. 2—CROSS-SECTION OF TUNNEL SHOWING TRUNK MAIN AND "FEEDERS."

The Murphy Company's system had been originally designed to operate at nearly atmospheric pressure and the underground mains were of low-pressure construction. The new piping was therefore arranged with the idea of carrying a low pressure on the trunk main and varying the pressure on the 12-in. feeders at the plant as required, in order to maintain a constant pressure on the trunk main. The feeders are built with extra heavy fittings and with

joints of the "Crane-lap" pattern. The connection of one of the feeders with the trunk main is shown in Figs. 3 and 4. The diameter of the feeder is gradually increased by means of the special taper fittings, in order to reduce the velocity of the steam before it makes the abrupt turn into the trunk main.

IMPORTANCE OF LONG-DISTANCE PRESSURE RECORDERS.

The success of such an arrangement as this is entirely dependent upon the possibility of having at the plant a reliable and continuous indication of the pressure existing at the remote end of the feeders. This requirement has been successfully met by the use of the recently-developed electrical long-distance recording gauge. This instrument comprises a transmitter located at the point at which the pressure is to be measured, and a recorder, similar in appearance to the ordinary recording instrument, located on the gauge board at the plant. Single phase alternating current at 110 volts is used to operate the instrument. In the transmitter the deflection of an ordinary pressure spring moves a pivoted armature. A similar armature in the recorder is magnetically constrained to move an equal distance, thereby deflecting the pen arm proportionately. The instrument is illustrated in Fig. 5. Aside from some trouble caused by the extreme conditions of heat and moisture under which the transmitters must operate, the instruments have proven quite satisfactory.

At the end of each of the feeders a transmitter is installed (see Fig. 4) and

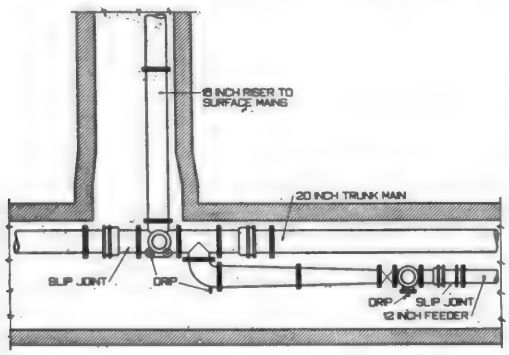


FIG. 3—CONNECTION OF ONE OF THE FEEDERS TO THE TRUNK MAIN.

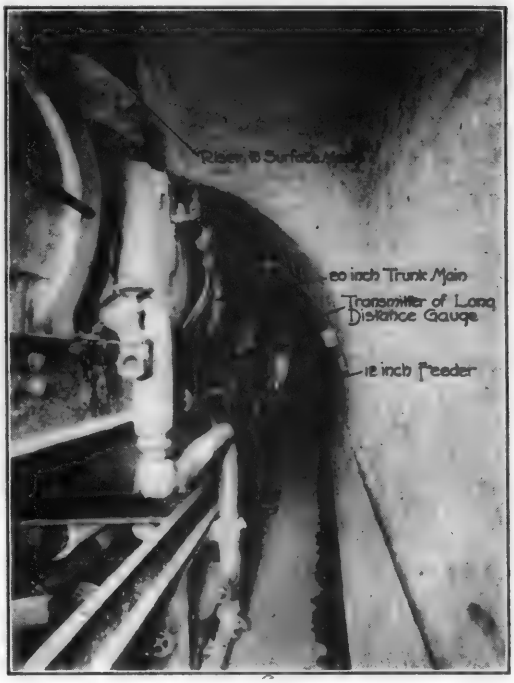


FIG. 4—VIEW IN TRUNK TUNNEL AT POINT OF CONNECTION OF FEEDERS TO TRUNK MAIN.

the recorders are located at the Park Place plant. The pressure on the trunk main is maintained at about 6 lbs. at all times. The load is ordinarily divided about equally between the two feeders and the pressure on the feeders at the plant is varied from 10 to 50 lbs. in actual practice. In moderate weather only one feeder is used. Fig. 6 shows a typical chart from one of the long distance gauges. The heavy black lines are drawn at the 5 and 7 lb. marks and the plant engineers are instructed to keep the pressure within these limits. With a pressure at the plant of 50 lbs., the load on each feeder is about 115,000 lbs. of steam per hour, with a velocity of 16,000 ft. per minute near the plant and 54,000 ft. per minute at the point where the feeder ties into the trunk main. On a few occasions a load as high as 155,000 lbs. per hour has been carried on one feeder, giving the very high velocity of 75,000 ft. per minute near the point where the feeder ties into the trunk main. This velocity is decreased to 27,000 ft. per minute in the taper fittings illustrated in Fig. 3. Under these conditions the steam is superheated about 60° F., due to the drop in pressure.

While there is, of course, a considerable amount of noise from the pipes, there is no excessive vibration and there seems to be no reason why the feeders could not be worked to their full capacity if necessary; that is, with boiler pressure on them at the plant.

TEST RESULTS CHECKED WITH UNWIN FORMULA.

During the winter of 1915-1916, some tests were made on one of the 12-in. Murphy feeders with a view to checking the actual capacity of the pipe against

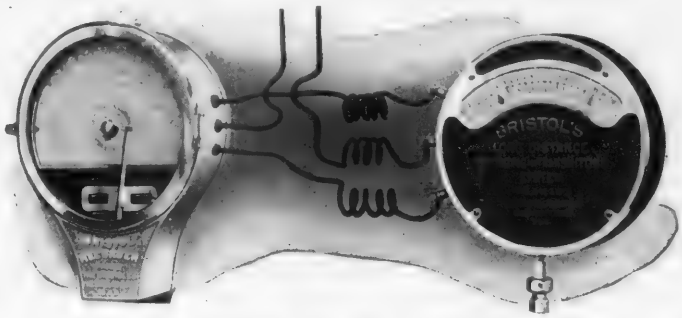


FIG. 5—THE LONG DISTANCE ELECTRIC PRESSURE RECORDING GAUGE.

Four feeders have since been installed in other parts of the Edison Company's heating system, operating on the same principle. They are shown in Fig. 7. Feeders A, B and C feed into a portion of the system upon which a pressure of 30 lbs. is maintained. Each is provided with a long-distance gauge and the pressure carried on them at the plant varies from 35 to 80 lbs. Feeder C is in a tunnel and, in addition to the long distance gauge, a hydrostatic pressure line is brought back to the plant, serving as a check on the long-distance gauge. Feeder D was installed to supply live steam to the lower end of the upper portion of the system, which is operated at exhaust steam pressures. The presseure on the 18-in. trunk main had been raised to the safe working limit and the installation of this 12-in. pipe obviated the necessity of enlarging the trunk main. None of these feeders are loaded up to full capacity, as they were designed to take care of future requirements of the system, which is growing at the rate of about 230,000 sq. ft. of radiation per year.

Besides allowing the use of small pipes, it is evident that this method of feeding steam places the control of the pressures throughout the system in the hands of the plant engineers and tends to increase the liability of the service to the consumer—a factor of increasing importance.

the figures computed from the well known formula of Unwin:

$$P = \frac{0.0001306\ W^2\ L\ \left(1 + \frac{3.6}{d}\right)}{y\ d^5}$$

P = Drop in pressure, lbs. per sq. in.
W = Weight of steam flowing, lbs. per minute.
L = Length of pipe, ft.
d = Diameter of pipe, in.
y = Mean density of steam, lbs. per cu. ft.

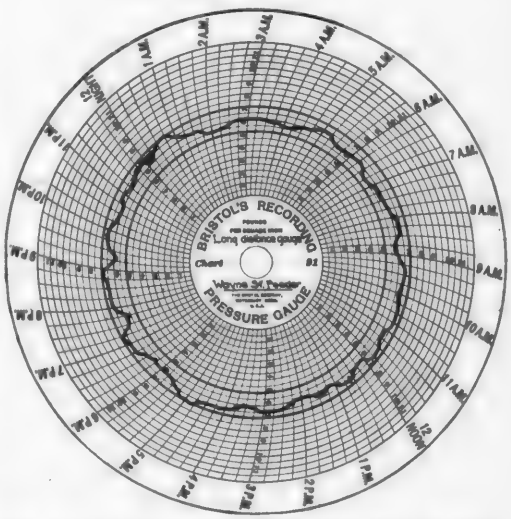


FIG. 6—TYPICAL CHART FROM ONE OF THE LONG-DISTANCE GAUGES.

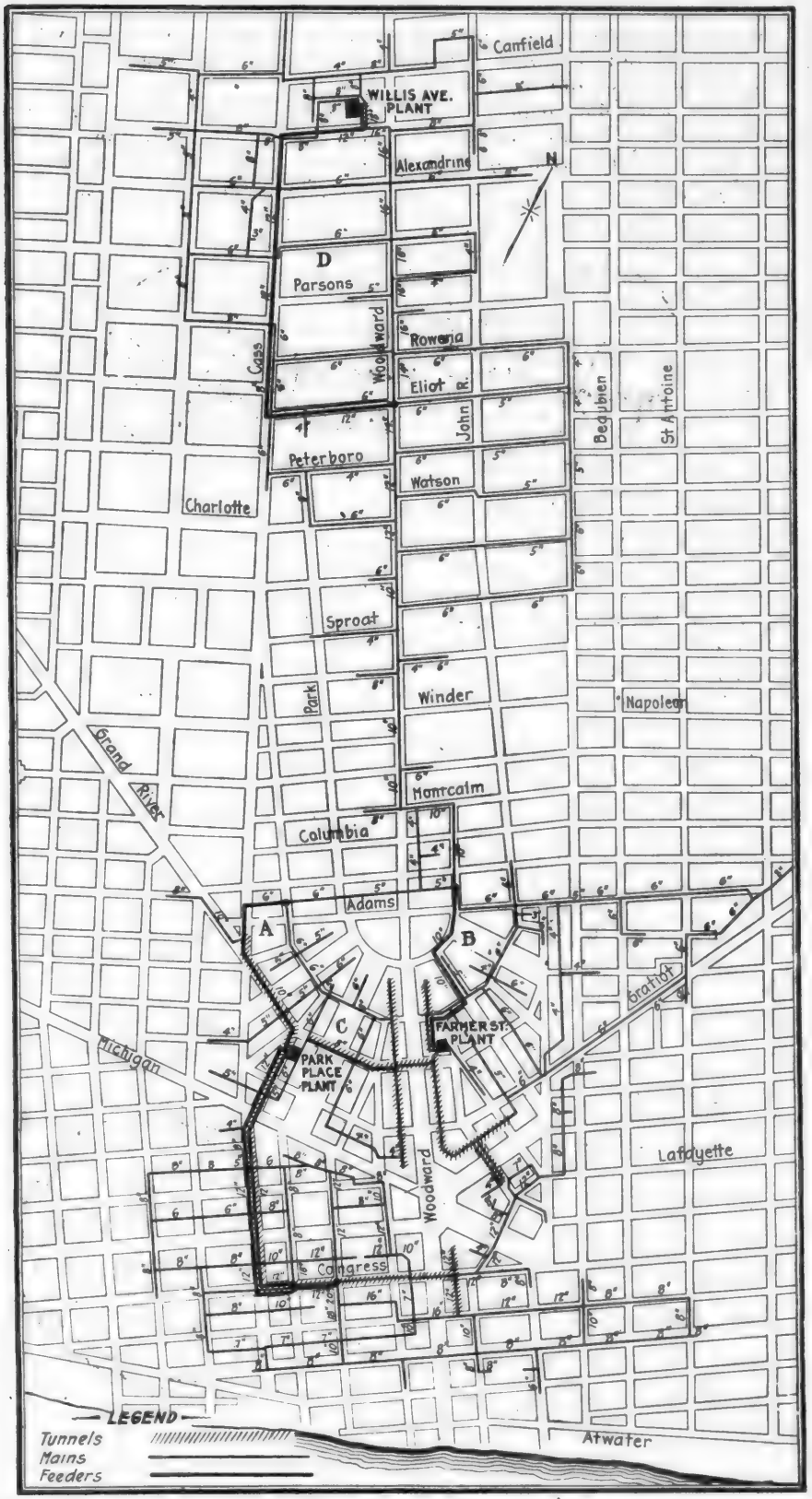


FIG. 7—MAP SHOWING THE FOUR FEEDERS SUPPLYING DIFFERENT SECTIONS OF THE DETROIT EDISON COMPANY'S HEATING SYSTEM.

The steam flow through the pipe was measured with a General Electric Company flow meter of the RS-2 type, equipped with a pressure compensating device. This meter was checked several times during the tests with a meter of the TS-3, or visible mercury column type, attached to the same pitot tube. The pressure at four points along the 1900 ft. length of pipe was measured with open mercury columns. The connections to these mercury columns were taken either from the drip connections or from openings tapped into the pipe wall. The steam temperature was observed at two points with mercury thermometers immersed in mercury wells which were inserted into the 12-in. pipe. Readings were taken on all of the instruments at the same instant, at a signal given by flashing the lights in the tunnel. The amount of steam flowing was varied by steps and several readings were taken at each step. The steam was in a superheated condition at all points in the pipe. The drop in pressure along the pipe for various quantities of steam flowing is illustrated graphically in Fig. 8.

The values for W, the steam flow, were computed by means of the Unwin formula, from the pressure drop through each section of the pipe. A comparison of these computed results with the actual steam flow as read from the steam flow meter showed surprising results, the computed quantities being much less than the actual observed quantities. In Fig. 9, the ratios of the actual to the computed steam flow are shown graphically. These points represent the results of about seventy-five sets of readings taken during three separate tests. It will be noted that the results for the successive sections of the pipe for each quantity of steam flowing are in fairly close agreement, especially at the higher rates of flow where the pressure drops were larger and the effect of the errors of observation were consequently reduced. The tests are not of sufficient scope to warrant an attempt at revising the formula, but they certainly indicate the necessity for further research.

New Book.

COMBUSTION IN THE FUEL BED OF HAND-FIRED FURNACES is the title of Technical

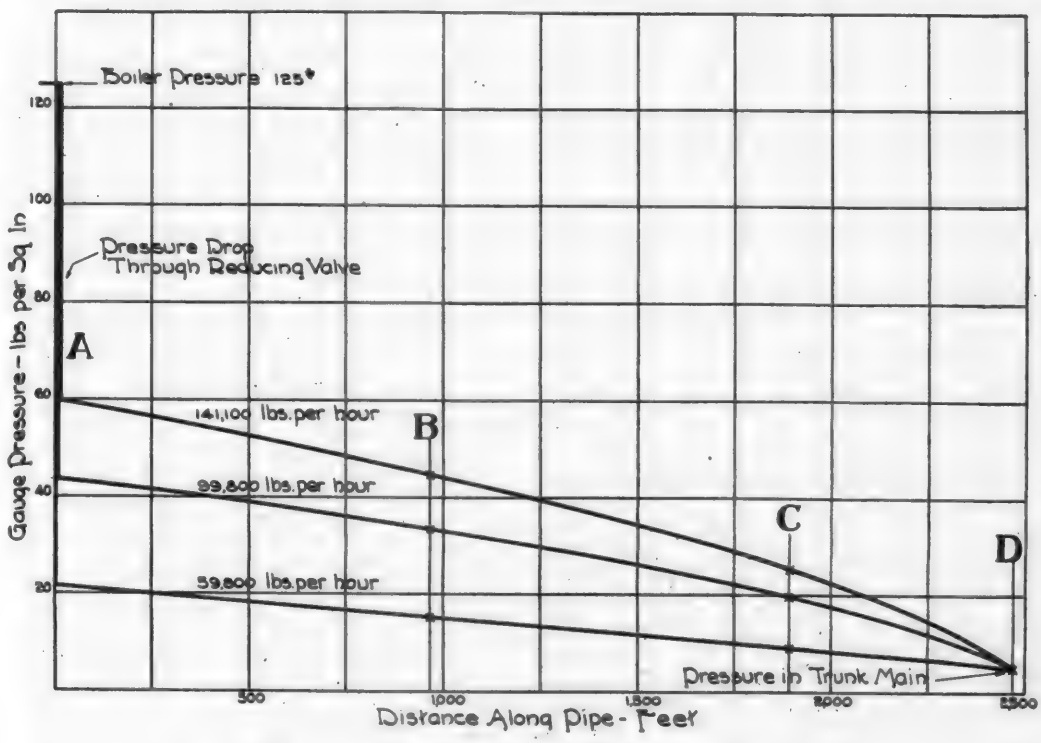


FIG. 8—PRESSURE DROP IN 12-IN. FEEDER FOR VARIOUS LOADS.

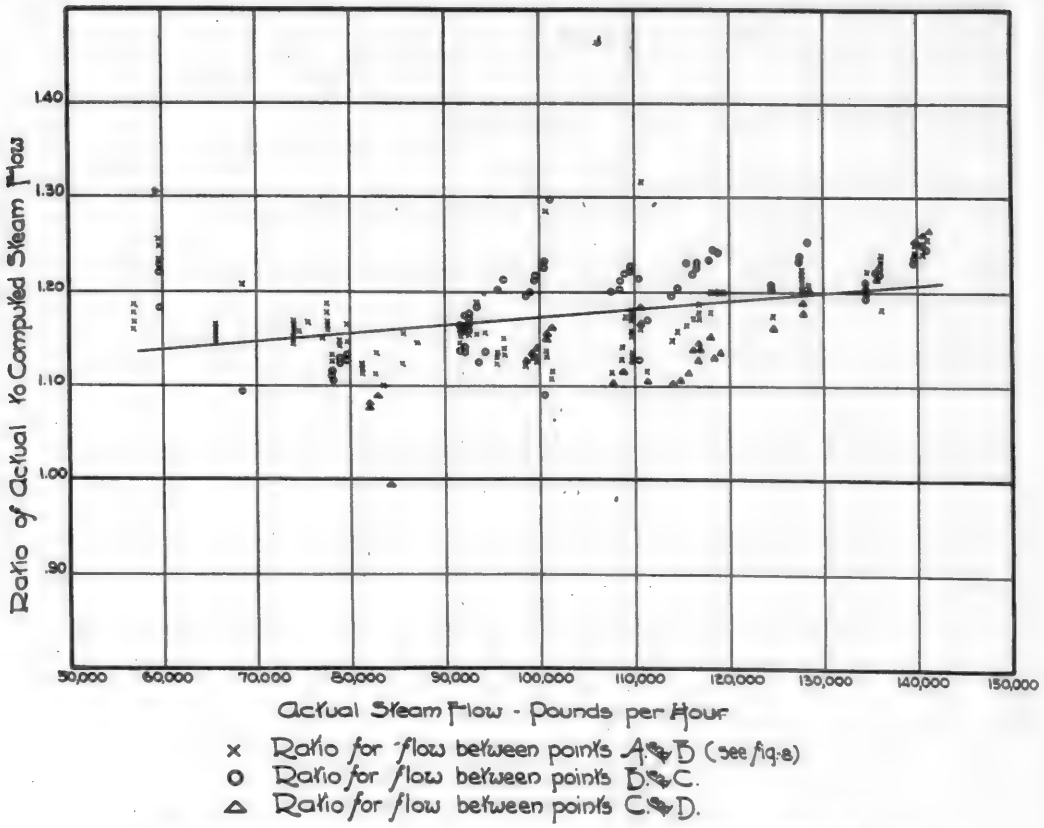


FIG. 9—RATIOS OF THE ACTUAL TO THE COMPUTED RATES OF STEAM FLOW.

Paper 137, by Henry Kreisinger and others, which has just been issued by the Bureau of Mines of the Department of the Interior. The main object of the investigation was to determine the conditions governing the process of combustion in the fuel bed of a hand-fired furnace. The results of this investigation furnish data for correct design of coal-burning grates and furnaces and their efficient operation. They also cast light on the important problem of clinker trouble as related to fusibility of ash, and indicate the possibility of a high rate of gasification of coal in gas producers. The first part contains general information on the combustion of coal in furnaces. What combustion is and how the process of combustion takes place is explained, also how much air is needed to burn one pound of coal and how the air and the coal are brought together to effect combustion. The method of feeding coal and air in four types of commercial furnaces is shown and discussed. The second part contains the description and the results of about fifty tests made in a small experimental hand-fired furnace, which was designed for an accurate study of the processes of combustion in the fuel bed.

The third part discusses the investigation described in the second part of the report, and includes about forty charts that show the composition of the gases and the temperature at different depths in the fuel bed of a hand-fired furnace, and various relations between the air supply and the rate of combustion.

The fourth part contains miscellaneous data on the composition of gases rising from the fuel bed of a hand-fired furnace under a steam boiler, a Murphy stoker, and a Jones underfeed stoker. Copies of this technical paper may be obtained free of charge by addressing the Director of the Bureau of Mines, Washington, D. C.

SOME MODERN METHODS OF VENTILATION, with special reference to public buildings, and including standards of ventilation, design of ducts, selection of fans, washers and heaters, specifications, test forms and specimen schedules for designers, is the title of a new book, written by R. Grierson, a well-known English mechanical and heating engineer. The book was first published in England two years ago and is now gotten out in an American edition. It is designed as a comprehensive treatment of the subject of ventilation, starting

out with the general principles of ventilation, the apparatus employed, ducts and registers, fans, etc. The chapter on considerations to be observed in the design of the air circuit is an interesting presentation of the laws regarding velocity variations. A mathematical presentation is also made of the relation between velocity and pressure head. In the chapter on heaters, several English types are shown, together with the well-known Vento type and some comparisons are made, especially with reference to the full data published on Vento heaters and the English method of rating such apparatus in "length of 4-in. pipe, and then complain of foreign competition." A chapter is also included on ozone, accompanied by an English type of ozone machine.

Throughout the book generous mention is made of American apparatus, especially in connection with temperature-controlling devices. Methods for making tests of ventilating apparatus are given in detail, the book concluding with "suggested schedules for designing" and a typical set of specifications. Size 5½ x 8½ in. Pp. 187, with 37 illustrations and 40 tables. Price $3.00. Published by the D. Van Nostrand Co., New York, or may be had through the book department of THE HEATING AND VENTILATING MAGAZINE.

The Inventor of the Ross Valve.

The death of George Ross, founder of The Ross Valve Manufacturing Company, and the inventor of the Ross valve, which occurred February 9, at his residence in Troy, N. Y., marks the passing of a man who had a typical American career and who achieved a substantial measure of success.

Mr. Ross was a native of Scotland and lived to the ripe old age of 87 years. He came to this country in 1851, having previously learned the trade of carpenter and pattern-maker. During the Civil War Mr. Ross was engaged in the manufacture of gun carriages in the Watervliet Arsenal, where he became noted for his mechanical skill.

About 1878 Mr. Ross obtained his first patents on the Ross valve. Soon after he started the business of the Ross Valve Manufacturing Company. The principal user of the Ross Valve was the United States Government, but the valve became known and was sold all over the world. Although noted as a high-pressure valve it could be regulated at low pressure and it came into use on some of the largest water systems in the country. Despite the fact that the plant was not operated on a very large scale, the reputation of the valve became widespread due to the quality of workmanship initiated and maintained by Mr. Ross.

Mr. Ross's three sons, John C. Ross, Adam C. Ross, 2nd; and William Ross, will continue to operate the business, as they have done since the retirement of their father some years ago.

Suggestions for Auxiliary Gas House-Heating.

A correspondent of *Gas Institute News* writes: "I heat my house with hot water American radiator equipment. Tens of thousands of others do the same. We have public service gas supply. Why have not you gas people evolved some appliance that we can stick into our fire pots and do away with coal? An enormous outlet for the gas industry, yet seemingly unrealized. Coal $8.50 per ton.

"I have read with interest scientific treatise on the subject. What would be even more interesting would be the plain record of John Jones, first with his coal hot-water heater buring coal one whole winter, then the same heater equipped with gas one whole winter."

In replying to the correspondent the following was contributed by C. C. Winterstein, chairman of the house heating committee of the American Gas Institute:

"In direct contradiction to what apparently is the correspondent's belief in the matter, this injuiry touches upon a subject that is one of the most mooted and liveliest questions in the gas industry today. This subject is still in its infancy, but it is being quite thoroughly investigated, and as many available data as can be obtained are being compiled with a view towards the determination of certain fundamental facts concerning the subject from its practical side.

"To the best of my knowledge, the mere installation of burners in the fire-box of a coal heater does not result in a very commendable gas house heater, due to the fact that the heat absorbing elements of the coal appliance do not adapt themselves favorably to the obtainment of a high efficiency when used with gas. Other changes would be necessary to increase the efficiency of the converted coal heater, the nature of these changes being largely dependent on the particular conditions surrounding each individual installation. It would seem that the best course to follow would be to provide a suitable auxiliary gas equipment, which would supplement the coal appliance and could be used during the mild seasons.

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IF a proposed new law designed to govern the practice of architecture, which has recently been proposed in California, should be enacted, it would look as if the ranks of the heating and ventilating engineers in that State would be swelled by a body of men to be known as "structural engineers." The proposed law, which has been introduced in the State legislature as Assembly Bill No. 1126, starts out by providing that plans for all new buildings, except residences, and all alteration work which affects the strength and safety of the buildings, must be prepared by a person holding a certificate from the State Board of Architecture, and further provides that this board shall grant two kinds of certificates, one to "design and superintend the erection of buildings," and the other as "architect." Applicants must undergo examinations in order to procure either kind of certificate.

An applicant for a certificate "to design and superintend the construction of buildings" shall be examined as to (*a*) his practical experience, technical knowledge of materials, their strength and use in practical construction, his ability to compute mathematically the strength and stresses in materials and structures, and ability to design a building or structure so as to insure inherent stability and strength in all its parts and to meet the contingencies and problems of construction and public safety that arise in the erection of buildings; (*b*) theoretical and practical knowledge of sanitation as applied to buildings, and his ability to design plumbing systems; (*c*) knowledge of the theory and design of heating and ventilating systems, and his practical understanding of the various systems in use; (*d*) his knowledge of stereotomy; (*e*) his knowledge of specification work; (*f*) his general education and knowledge of architectural terms, together with his character and fitness for a certificate.

The holder of either certificate will be entitled to prepare plans and superintend the erection of buildings of every kind. Persons securing a certificate as "architect" will be entitled to use the word "architect" as designating their profession and to advertise as such, but it is made unlawful for any one else to use the word "architect" or any derivation in any way which might result in designating such person as an architect. Persons holding a certificate "to design and superintend the erection of buildings" will be entitled to use the words "structural engineer" to designate their profession.

The proposed law further provides that it shall be unlawful to construct, erect, alter, add to, repair or reconstruct any building, if the work affects the strength and safety of the building, except residences, unless plans for the work are prepared by and the work done under the supervision of a person holding a certificate "to design and superintend the erection of buildings" or as "architect."

Re-Establishment of Temperature Control on a Central Station Hot Water Heating Plant.

The Peru Heating Company, in Peru, Ind., installed its central heating plant during the summer of 1902. In this plant the Powers system of temperature control was used. This type of control gave uniform satisfaction so long as the air lines could be maintained. In the instance of Peru, however, the air lines failed after being in service some eleven or twelve years.

Several methods have since been tried to re-establish the temperature control as it was at once recognized that the usual method of charge for hot water heat, namely, the square foot basis, demanded that some means of control on the service must be employed.

The devices tried were not without merit, but the engineers were always confronted with the fact that all or a part of the old control would have to be abandoned unless some control could be devised that would salvage the valves and thermostats. This was accomplished by converting the Powers compressed air thermostat into an electric thermostat by attaching little contacts on the face of the same, without disturbing the thermostatic element or adjustment in any way.

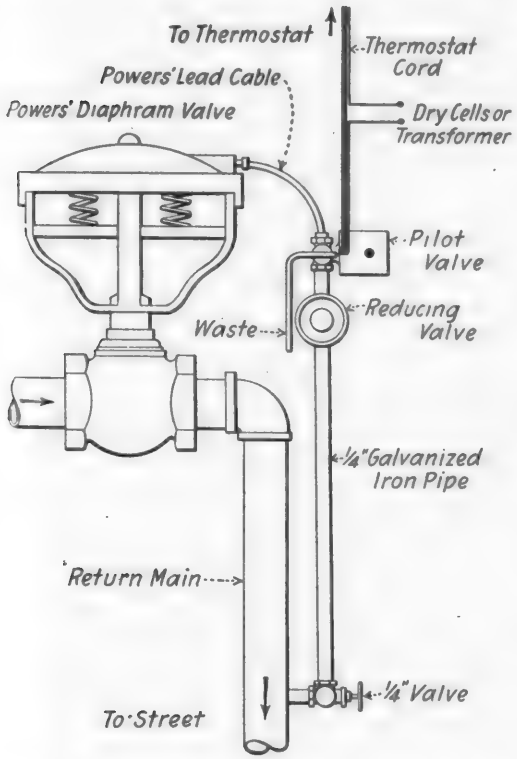


FIG. I—ARRANGEMENT OF PILOT VALVE IN CONNECTION WITH MAIN POWERS DIAPHRAGM VALVE FOR RE-ESTABLISHING TEMPERATURE CONTROL.

Fig. 1 shows the general scheme of installing the pilot valve in connection with the main Powers diaphragm valve in the basement. It will be noted that where test cocks are installed it is not necessary to cut into the line; in fact, the conversion is usually made without closing off the service. Moreover, all of the old equipment is re-employed, except some armored lead cable, which is replaced by a three-wire thermostat cord.

The water for operating the diaphragm valve is taken from the return line through a small Powers reducing valve, if the pressure is excessive for the diaphragms. The amount of water required is represented by the number of operations of the valves and is very slight. The pilot valve is of the magnetic type and is operated, through dry cells or bell ringer transformer, by the thermostat, and simply permits water to pass to the diaphragm or from it thus shutting off the service or opening it as the thermostat may demand.

In this connection it is interesting to note that there are about 100 control outfits on this plant, most of which have been installed 15 years and in every case the old rubber diaphragms on the valves, as well as the thermostats themselves, were found in such good condition that no repairs have been found necessary, even though a considerable part of the apparatus went through the flood four years ago.

The re-establishment of the temperature control at Peru is in line with the accepted policy of "equal service" to all the consumers and when completed will place the plant on an operating basis regulated by temperature and pressure charts, as well as by the pumpage records, coal consumption curves, CO_2 records, stack temperatures and stack drafts.

The change in temperature control was devised by J. C. Hornung, of Chicago.

Electric and Steam Service in Hotels, Department Stores and Office Buildings.

If grandfather could come back in his prime to-day, in place of the "old inn" or "tavern," with its candle light in the window to guide the traveler to the doorstep, he would see, when yet many blocks away, the mammoth electric sign of the modern hotel. Upon arriving he would register and would be whirled toward the roof by central station service, to a room lighted and heated by central station service. He

would take a bath in water heated by central station service, would don clean linen laundered by central station service, would go down to a dinner cooked with central station service, drink a glass of water cooled by central station service, and enjoy his repast in an atmosphere of washed air tempered by central station service. The same is true of the modern department store and office building, although somewhat modified in degree of service. — *W. P. Whittington, of the Springfield (Ill.) Light, Heat & Power Company, before the New Business Co-Operation Committee, Cincinnati, O.*

Maximum Temperature in Which a Workman Can Work.

What is the maximum temperature in which a workman can work without undue discomfort or injury to his health? This question was asked recently by a correspondent of *Safety Engineering.*

The inquiry was referred to Frederick L. Hoffman, Statistician of the Prudential Insurance Company of America and the following views are the result of his investigation of this important subject:

Mr. Hoffman bases his reply on the assumption that the question is limited to the qualification as to the extreme heat possible in a drying room in which heated air is used and in which workmen are required to handle materials. Perhaps a typical illustration, he says, would be the drying room of a linoleum works in which practically all the moisture is extracted from the atmosphere and in which, as a consequence, acrolein is developed, which is considered more or less injurious to health. Thus, extreme heat and extreme dryness may be complicated by chemical factors, even more injurious than dry heat itself. Of course, extreme heat coincides with extreme atmospheric dryness which, as such, is injurious to health. It is usually considered that a relative humidity of less than 30% is injurious to the human organism.

The second question is the degree of continuous exposure. Mere heat exposure, especially radiant heat in front of furnaces, even though over 2,000° F., is not seriously injurious, in that it is rapidly disseminated and felt at most only by the front surface of the body for a very short period of time. Such heat exposure obviously does not require consideration in answer to the question.

The third factor, and perhaps the most important, is bodily exertion under extreme heat accompanied by extreme dryness. Such bodily exposure is much less trying under extreme dry heat than under extreme degrees of atmospheric moisture accompanied by relatively high, but not abnormal, temperatures.

According to the most recent treatise on "The Diseases of Occupation" by Kober and Hanson, "exposure to dry heat for a short period is sometimes borne without serious effects in temperatures as high as 140° or 150° F., provided the air is kept in motion." This condition, of course, is radically different from excessive temperature exposure on the part of puddlers and electric furnacemen, who, for a very brief period, may be exposed to temperatures of 212° F., etc., without serious injury. Mr. Hoffman states that he is inclined to think that a radiating temperature may very materially exceed this figure without serious bodily injury, even though burns may be caused, which usually are of less consequence. It is said in the work referred to that "prolonged exposure, however, is usually followed by grave constitutional disturbances; these need not to be gone into." It is also said that "the men engaged in handling molten metal and all others exposed to radiant heat not infrequently suffer from dermatitis, an inflammatory condition of the eyes, and even cataract, induced by the partial dehydration." This, in fact, is perhaps the most serious effect of extreme heat endured for a short period of time, but at frequent intervals.

The most scientific treatise on the subject is an address on "The Effects of Exposure to Intense Heat on the Working Organism" by Surgeon Charles N. Fiske of the United States Navy, published in the Transactions of the fifteenth International Congress on Hygiene and Demography. Most of the observations have reference to heat affections in the navy, but they may possibly be more applicable to the question than information derived from other occupational experience. Referring to the temperature of the berth accommodation on the *Marblehead*, which was from 90° to 92° F., it is said that this heat rendered it almost impossible to obtain refreshing rest. The fire room, however, had a temperature as high as 140° and it is said by Dr. Fiske that he, himself, had observed a temperature as high as 186°, but that the average was 120° and in the engine-room from 105° to 110°. Under these conditions, however, work was considered endurable and no very serious cases of illness were experienced.

On submarines, under conditions of active service, equally high temperatures,

if not higher, have been endured without fatal results. One of the best authorities on this subject is Prof. Frederic S. Lee of Columbia University. He directs particular attention to the importance of air movement as separate and distinct from mere heat and humidity. He remarks: "In proportion, however, as the temperature of the air approaches or surpasses that of the body and the humidity of the air is sufficient to prevent the evaporation of sweat, loss of bodily heat by the customary channels becomes lessened. Without adequate means for eliminating the heat that is being constantly produced within, the internal temperature rises and a febrile condition results. Such a state is reached the sooner the more mechanical work is performed and the more heat is thereby produced. Its oncoming is favored also by a lack of movement in the air. With a continuance of the unfavorable environmental conditions a simple rise of internal temperature may pass into a higher fever characteristic of simple heat prostration, or a moderately severe heat stroke with a temperature up to 40.6° C. (105° F.), and finally into the hyperpyrexial or intense form of heat stroke, in which the bodily temperature has been known to rise to the phenomenal height of 47.6° C. (117.8° F.)."

Mr. Hoffman is of the opinion that the best practical information can be obtained from those in charge of linoleum works. Certainly in his own experience the temperature conditions there were the most trying of which he has knowledge. They do not compare with, but are in contrast to the excessive heat experienced in the lower levels of the Comstock Lode. A comparison really is difficult, if not impossible, for totally different bodily effects are experienced. In the Comstock Lode the air suffers also chemical contamination, as is the case in the drying-rooms of linoleum works.

In his investigations at steel plants, Mr. Hoffman states that he does not recall excessive temperatures much over 120° F., as far as actually determined. The enormous heat inside the furnace may be over 2,000°, but it dissipates so rapidly in the general atmosphere that, as shown by the government report on labor conditions in the iron and steel industry, it rarely, if ever, exceeds 147° F., which was ascertained 12 ft. away from the tap-hole of a furnace. Such a heat, of course, does not affect the body as a whole, which can only be said to be the case in a close compartment, such as the drying room of a linoleum plant or the engine room of a submarine.

It is stated by Dr. W. Gilman Thompson that the oil mixture in linseed manufacture is heated to approximately 450° F., during which progress certain fumes are evolved. This temperature, however, has no reference to the heat conditions in the drying-room. In linseed oil manufacture the substance is mashed and pressed to a temperature of 125°, but whether the men are exposed to this heat for a sufficient length of time to be injuriously affected, is not made clear by the available discussion. It is said that the workmen are protected from the excessive heat by drafts of compressed air.

According to an investigation by Mr. Hoffman, made some years ago, the temperature in drying chambers at linoleum plants may be raised as high as 180° F., but this temperature may possibly not prevail when the rooms permit ingress and egress on the part of the workmen, while placing in or taking out rolls of linoleum. Of course, the time exposure on the part of these men is relatively short and it should not be understood that the work as such is seriously injurious or exactly proportionate to the degree of temperature exposure for a very limited period of time. The effects of sudden and radical temperature changes may, in the long run, be more seriously injurious to health than short-time exposures to high temperature, even though the latter are experienced at frequent intervals over comparatively long periods of time. This, however, is debatable.

Current Heating and Ventilating Literature.

Under this heading is published each month an index to the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

HOT WATER

Hot Water Heating. Ills. 1,500 w. Prac. Eng., Chi.—Jan. 1, 1917. Systems employed and their connections. 60c.

HOTEL PLANT

Power Plant of Hotel Traymore. Walter C. Edge. Ills. 2,000 w. Nat. Engr.—Jan., 1917. Equipment. 20c.

INDUSTRIAL PLANTS

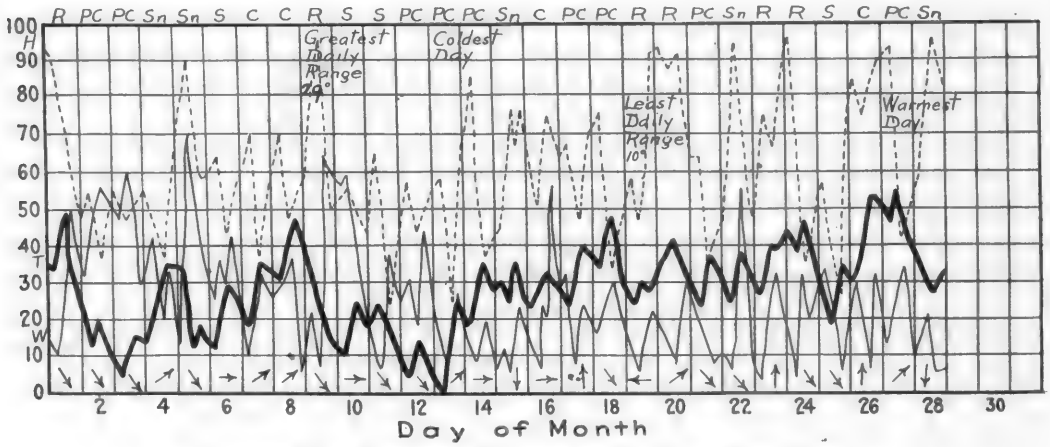
The Heating of Machine Shops. Ills. 1,200 w. Cas. Eng. Mthly.—Dec., 1916. Methods. 40c.

VIBRATION

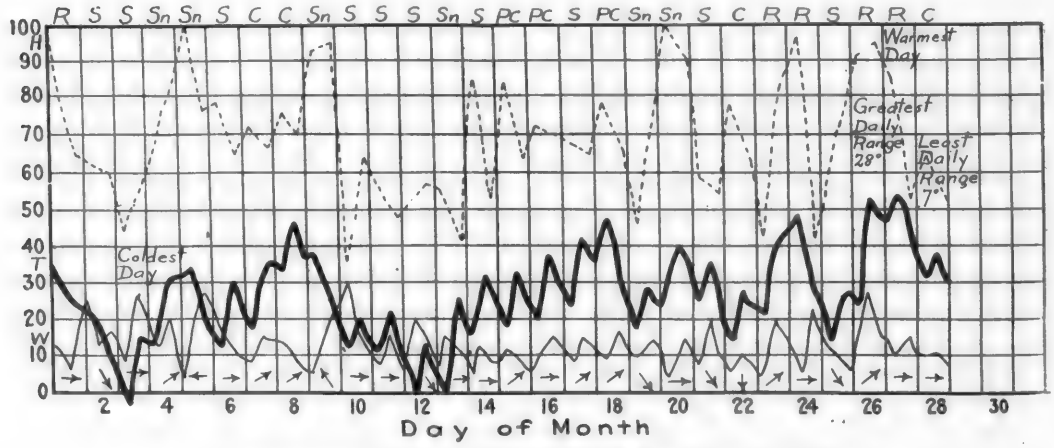
The Prevention of Vibration in an Apartment House. Ills. 1,200 w. Power—Jan. 2, 1917. Trouble overcome by changes in piping and installing shock and sound arresters. 20c.

The Weather for February, 1917

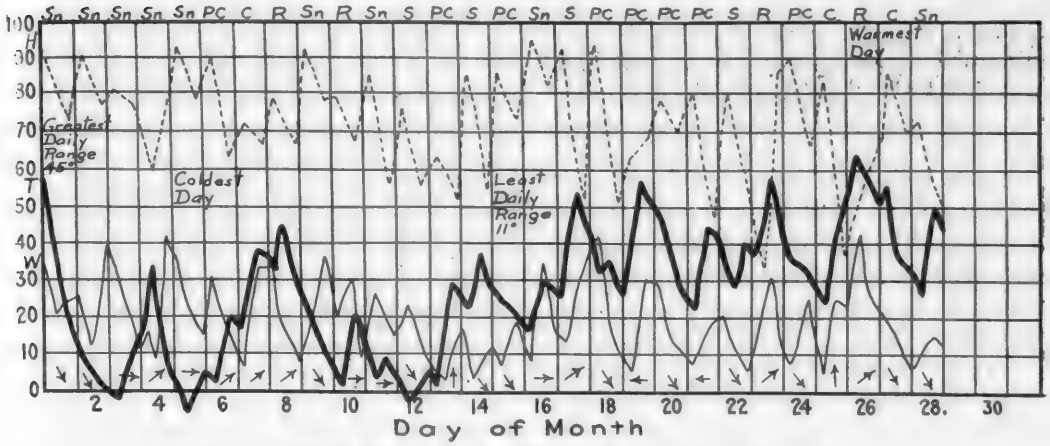
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F.	55	53	64	50	68
Date of highest temperature	27	27	26	25	25
Lowest temperature, degrees F.	0	—3	—6	—10	—10
Date of lowest temperature	13	3	5	2	2
Greatest daily range, degrees F.	29	28	45	30	39
Date of greatest daily range	9	26	1	22	4
Least daily range, degrees F.	10	7	11	5	7
Date of least daily range	19	28	15	18	18
Mean temperature for month, deg. F.	28	26	27	19.8	30.4
Normal Mean Temp. for month, deg. F	30.7	28	31.8	25.4	33.5
Total rainfall, inches	1.70	2.67	0.99	0.67	0.35
Total snowfall, inches	12.2	8.4	3.4	4.5	1
Normal precipitation, this month, in.	3.87	3.56	2.66	2.16	2.75
Total wind movement, miles	13965	8045	9564	9498	10023
Prevailing direction of wind	N.W.	W.	N.W.	N.W.	N.W.
Average hourly wind velocity, miles	20.8	12	14.2	15.6	"14.9
Number of clear days	4	12	5	10	7
Number of partly cloudy days	14	8	12	10	10
Number of cloudy days	10	8	11	8	11
Number of days on which rain fell	11	11	10	8	4
Number of days on which snow fell	5	6	9	5	1
Snow on ground at end of month, in.	3.6	None	Trace	None	None



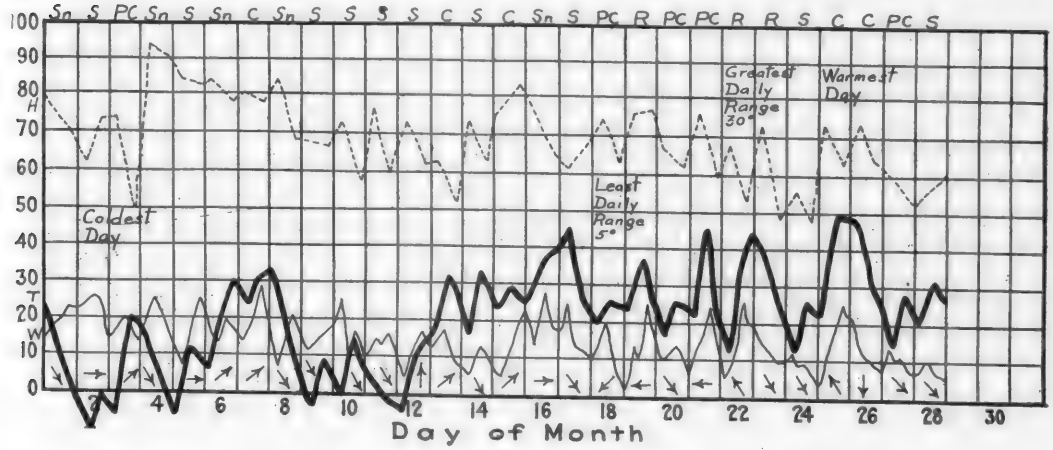
RECORD OF THE WEATHER IN NEW YORK FOR FEBRUARY, 1917.
(Hourly Observations of the Relative Humidity are Recorded on this Chart.)



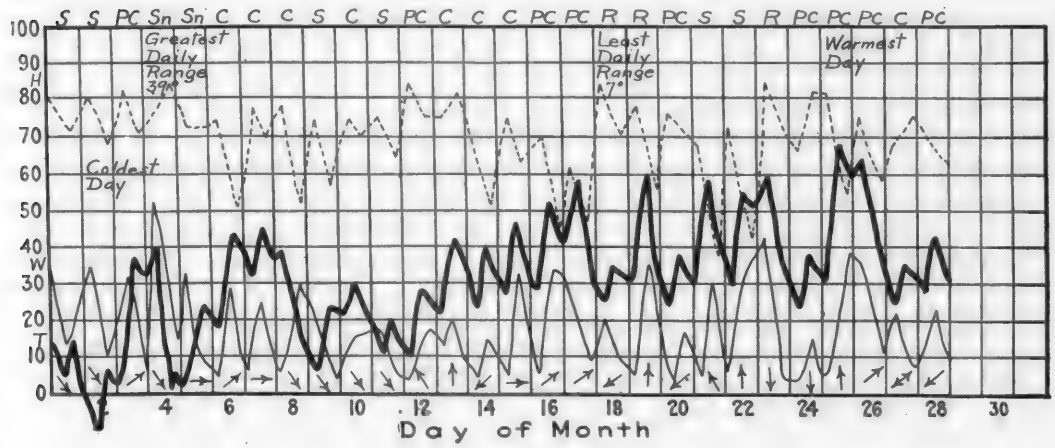
RECORD OF THE WEATHER IN BOSTON FOR FEBRUARY, 1917.



RECORD OF THE WEATHER IN PITTSBURGH FOR FEBRUARY, 1917.



RECORD OF THE WEATHER IN CHICAGO FOR FEBRUARY, 1917.



RECORD OF THE WEATHER IN ST. LOUIS FOR FEBRUARY, 1917.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Dates Selected for Society's Summer Meeting.

Announcement is made that the forthcoming summer meeting of The American Society of Heating and Ventilating Engineers will be held in Chicago, July 18, 19 and 20. These dates fall on Wednesday, Thursday and Friday.

It is expected that one of the papers to be presented at the summer meeting will be an elaboration of the address delivered at the March meeting of the Illinois Chapter on the hot water heating system at the plant of the Crane Company and plans are being made to take the delegates in a body for an inspection of this plant.

Heating Engineers' Society in New Quarters.

New quarters for the American Society of Heating and Ventilating Engineers have been taken in the Engineering Societies Building. The new offices are on the same floor as formerly but in a larger room—Room 712.

Volume 22 of the society's Proceedings, covering the transactions for the annual and summer meetings of 1916 has been sent out. It is a volume of 595 pages. In addition to the verbal discussions of the various papers and topics, are a number of written discussions which add materially to the value of the Proceedings.

Appointment of Committees on Boiler Code and Research.

President J. Irvine Lyle of the American Society of Heating and Ventilating Engineers has appointed two committees which are expected to accomplish important work for the society during the next year. One is a committee to formulate a standard code for the testing of low pressure heating boilers. This committee consists of Homer Addams, chairman; Prof. John R. Allen, J. J. Blackmore, Ralph Collamore, William H. Driscoll, Walter L. Fleisher, Louis A. Harding, James F. McIntyre, Edwin A. May, Percival H. Seward and Walter S. Timmis.

The other committee will investigate the matter of the establishment of a bureau of research, to be conducted under the auspices of the society. The personnel of this committee is as follows: George W. Barr, chairman; Harry M. Hart, Prof. James D. Hoffman, William F. McDonald, William W. Macon, James W. H. Myrick and Perry West.

Ventilation of Submarines Discussed by New York Chapter.

Practical and vital problems encountered in the ventilation of submarines and how the Navy Department is meeting them were presented at the March meeting of the New York Chapter, March 19, by Lieutenant E. D. McWhorter, U.S.N. The meeting was held at the Building Trades Club, with President Arthur Ritter in the chair. It was in charge of a committee headed by D. D. Kimball.

The fact that many of the chapter members had witnessed the submarine manouvers at New London last November added greatly to the interest in Lieutenant McWhorter's address, which was illustrated by lantern slides.

In opening his address Lieutenant McWhorter stated that he was after information rather than in a position to give it. He said the principal problem in the ventilation of submarines was in connection with storage battery ventilation. The electric batteries give off hydrogen gas in excessive quantities and this has to be taken care of to prevent dangerous accumulations. Then it is necessary to ventilate the electric motors when running submerged and also to remove the oil vapors that accumulate in the operation of the oil-fired Diesel engines. All of the foregoing is in addition to the general ventilation requirements for the ship's personnel. For the latter purpose a compartment of 150 cu. ft. area is provided in which compressed air is stored at a pressure of 2,250 lbs. per cubic inch. For general ventilation purposes, when running on the surface, there are usually two 600-cu. ft. supply blowers driving air through ducts to the various points of the hold and two exhaust blowers of the same capacity exhausting the air outboard.

The new types of submarines, said Lieutenant McWhorter, can easily go from 24 to 36 hours submerged, without resorting to any chemical means of renewing the air supply. By the use of such chemical means it is possible to stay submerged as long as ten days.

The danger of hydrogen gas explosions is the important item as this gas becomes an explosive at a concentration of 3½% or 4%. For this reason it is necessary to have a separate ventilating system for the bat-

tery cells. On the surface this system exhausts outboard but when submerged the gas is carried to another part of the vessel and mixed with the other air and recirculated. Regarding the oil vapors, the same procedure is followed except that the oil vapors can be expelled from the vessel when running submerged. If in the vicinity of enemy vessels, however, this would leave a streak of oily water that would betray the vessel's presence. Another reason for separating the ventilation of the engine room from that of the motors is that the oil vapors have a tendency to rot the insulation.

Regarding the air supply to the men themselves the speaker said that their allowance was 35 cu. ft. per hour and that it was a common experience to have the carbon dioxide run up to 200 parts in 10,000. Whenever the air got particularly bad or the heat excessive, electric fans were started that helped greatly to relieve the men.

In response to questions Lieutenant McWhorter said that the interior temperatures in submarines ran from 40° to 120° F. Submarines are very cold in winter and are particularly hot in summer.

He said a great many suggestions for improving conditions in submarines or adding to the facilities are thrown out on account of the lack of space available or the weight of the extra appliances. The submarine itself has to be very substantially built as the water pressure at a depth of 200 ft., for instance, is 89.7 lbs. per square inch. He said it was a mistake to suppose that the air pressure inside the submarines increases when deeply submerged as the hull of the vessel takes up all the pressure of the water. The principal effect on the part of the men of any extended submergence is that they usually experience a sleepy feeling on coming to the surface.

In the discussion of his address it was suggested that it might be possible to dispose of the excess hydrogen by combining it with oxygen and by means of a high tension electric current transforming the mixture into water. Lieutenant McWhorter said that this might be a good suggestion to work on, but it must be remembered that such an apparatus must be capable of handling 200 cu. ft. of hydrogen per minute and space would have to be found on the vessel for such apparatus.

On motion of Frank K. Chew three cheers were given for Lieutenant McWhorter for his interest in coming before the chapter and on the suggestion of William F. McKiever, the chapter will present the lieutenant with a suitable souvenir.

It was announced that the May meeting of the chapter, which will be the annual meeting, will be given over to "The Ventilation of Battleships." M. W. Franklin is the chairman of the committee in charge of the May meeting.

Crane Company's Hot Water Heating Plant Described Before Illinois Chapter.

"Hot Water Heating Under Forced Circulation, as Installed in the Crane Plant," was the subject of an illustrated address presented by S. H. McCreary, of the Crane Company, at the March meeting of the Illinois Chapter, March 12. The talk followed a chapter dinner at the Chicago Engineers' Club.

The speaker was introduced by President F. W. Powers. Mr. McCreary stated that the total cost of the new Crane Company plant would approximate $10,000,000 of which $1,000,000 would represent the cost of the heating equipment. The entire plant comprises 50 buildings covering an area of 50 acres and the company has an additional 160 acres adjoining its plant for possible future extensions.

No less than 300,000 sq. ft. of heating surface are now in service, arranged on six circuits in tunnel systems, aggregating a total length of 4,978 ft. The heating system contains 5,332 gal. of water and Mr. McCreary stated that the average drop in temperature of the water in making the circuit of the system is 16°. He stated that one day during the past winter, when the temperature outdoors was 10° F. below zero, the outgoing temperature of the water was 187° and the incoming temperature, 152°, giving a drop of 35°.

At the conclusion of Mr. McCreary's address and upon his request, President Powers gave a description of the system of temperature control installed in connection with the heating plant.

The large attendance at the meeting resulted in a lively discussion on the merits of hot water and steam heating, which was participated in by George Mehring, Robert A. Widdicombe, August Kehm, J. C. Hornung, Harry M. Hart, Dr. E. Vernon Hill, J. F. Tuttle and George H. Kirk.

Michigan Chapter Elects New Officers.

New officers were elected as follows at the annual meeting of the Michigan Chapter, which was held at the Fellowcraft Club, Detroit, February 23: President, Ralph Collamore; vice-president, J. R. McColl; treasurer, Harry A. Hamlin; secretary, Wil-

liam F. McDonald; board of governors. E. E. Harris, J. H. Walker and Thurlow E. Coon. The secretary's report showed the total membership of the society to be 76.

The March meeting, held March 19, was addressed by E. E. Harris, formerly chief engineer for Albert Kahn, architect, but recently associated with the Pittelkow Heating & Engineering Co., who described the heating and ventilation of the Ford Motor Company's factory. Mr. Harris was identified with this work so that he was able to give an intimate description of the installation. This was followed by a lengthy discussion in which many of the 58 members and guests present participated.

The April meeting will be held April 28, when J. R. McColl will present a paper on "The Fundamental Principles of Ventilation."

March Meeting of Kansas City Chapter.

Herbert W. Whitten was elected president of the Kansas City Chapter at its March meeting, to fill the vacancy caused by the resignation of Professor James M. Kent. Professor Kent was unable to serve on account of the press of other duties. R. F. Taylor was elected to the council to fill Mr. Whitten's place.

Following routine business which included the adoption of by-laws, the chapter took up for discussion the paper by Professor G. L. Larsen of the University of Wisconsin, on "The Recirculation of Washed Air in Buildings," which was first presented at the society's 1916 annual meeting. It was the consensus of opinion that while there could be no argument regarding the fuel saving accomplished by the recirculation of air, the chapter would not endorse the recirculation of washed air in school buildings for general practice.

The April meeting was scheduled for April 6, the subject being "Boilers and Smoke Prevention." A series of moving pictures by the Kewanee Boiler Company was to be shown in connection with the presentation of the subject.

It was announced that the chapter is in good shape, with approximately 30 members on the roll.

Alumni of New York School of Heating and Ventilation Hold Annual Dinner.

An attendance of over 150 guests and a corresponding degree of enthusiasm marked the fifth annual dinner of the Alumni Association of the New York Heating and Ventilating School, which was held at the Building Trades Club, New York, March 12. The outpouring of young men who have been taking the course of lectures given by Charles A. Fuller, during the past few years, was prophetic of the part they are going to play in the future of the heating profession, and their status as embryo users and specifiers of heating apparatus was further evidenced by the presence of many manufacturers, some of whom were frankly bent on "looking over the youngsters."

It was natural to make a comparison between this and the more technical organizations, such as the various chapters of the heating engineers' society. Many commented on the delightful informality of the alumni association's dinner and the comparative freedom from responsibility that characterized its proceedings. The whole affair, however, seemed to indicate that a new medium has been developed which really supplements the work of the strictly engineering organizations. Certainly it would be hard to find a more hearty spirit of good fellowship prevailing than that observed on the part of the alumni association and its guests.

After partaking of a dinner in which the various dishes were the subject of local hits, the speakers were introduced by E. A. Kingsley, who acted as toastmaster. The speakers included Frank K. Chew, Charles A. Fuller, Jack Armour and M. W. Franklin. These were followed by a representative of the first year class, Walter Klocksin; a representative of the second year class, R. A. Wolff; and a representative of the alumni association, M. J. Sage. Before and during the dinner music was rendered by Schmidt's orchestra.

Mr. Fuller said one of the most notable features about the school was the fact that several manufacturers were making it a practice to send their salesmen to the lectures, one firm having sent 12 men to the classes this year. Six firms in all had adopted the practice.

M. W. Franklin emphasized the growing need of heating and ventilating engineering in the industries. In many of the industrial processes, he said, where ventilation was formerly advocated from an altruistic standpoint, it is now recognized as vitally important from the purely practical standpoint of increased efficiency. He then spoke of the rise of chemical engineering and reminded his hearers that most of the processes in chemical engineering depend on the application of heat, so that this field is opening up great opportunities to the heating engineer.

CORRESPONDENCE

Heat Transmitted from Radiators with High and Low Pressure Steam.

EDITOR HEATING AND VENTILATING MAGAZINE:

Will a radiator supplied with high pressure steam give off more heat than when supplied with low pressure steam?

The relative heating effect of a radiator using high and low pressure steam depends largely on the specific heat of the iron in the radiator as it takes far more heat per square foot to raise the temperature of the cast-iron to the working point than it does to replace the heat losses after the iron comes up to a working temperature.

The specific heat of superheated steam changes considerably, but the higher the superheat the less the specific heat. This varies from 0.7 at 200 lbs. saturated to 0.63 at 150 lbs. to 0.57 at 100 lbs. pressure, to 0.51 at 50 lbs. pressure, to 0.47 at atmosphere and to 0.45 at absolute zero pressure.

The specific heat of the steam, it should be noted, has nothing to do with the heat given off by a radiator, provided there is an ample supply at the stated pressure; if the supply is curtailed, the pressure is changed. The only governing factor is the difference in temperature of the room and radiator and the velocity of the air passing over the heating surface.

Where the specific heat of the steam does come in is that it takes a slightly fewer number of pounds of steam to supply a given amount of heat at one pressure than at another, but the amount of heat actually delivered will be according to the difference in temperature of the room and the steam. Naturally, high pressure steam will give more heat, as the temperature is higher.

Condensation on School Room Walls.

EDITOR HEATING AND VENTILATING MAGAZINE:

In a room in one of our schools we had a peculiar condition arise during the very cold weather in February, which I would be thankful to have you explain.

The room in question is in a 12-room brick building and is on the southwest corner of the second floor. It has windows in both the south and west walls. During three or four days, when the outside temperature was down to zero or below, the condensation or sweat formed on the walls and ceiling of this room so heavily that school had to be dismissed. The water ran down the walls in streams and dripped off the ceiling so that the floor looked as if the roof had been leaking all over.

An examination of the attic space over the room showed that the roof was perfectly tight. Furthermore, the plastering of the ceiling itself was perfectly dry. The room is heated by direct radiation under the windows and has no water or steam pipes in the floor, walls or ceiling.

I feel that this condition was undoubtedly brought about by the atmospheric conditions, but the point which puzzles me is why we did not have trouble with any of the other rooms since, as accurately as I could ascertain, the conditions were absolutely the same.

Louisville, Ky. H.

We do not know of any natural condition of the atmosphere which could be obtained in zero weather that would give the trouble experienced by our correspondent. In fact, the great difficulty in extreme weather consists in raising the humidity indoors to a proper point and we have never known walls or ceilings to sweat at such times. To produce such steaming or sweating two conditions are necessary: first, that the relative humidity of the warm air in the room must approach saturation; and, second, that the cooling surface must be cold enough to cause the air in contact therewith to fall so much in temperature that its point of saturation is passed, causing the excess moisture to be deposited on the nearest surface, which is always the cooling surface.

Glass being a better transmitter of heat than a wall consequently exposes a colder surface to the air in the room and, therefore, the steaming of a window always precedes the sweating of a wall—unless the wall had been standing cold for a long period—in which case it would warm up more slowly than the glass and sweat first. If the glass is sufficiently cold the condensation is frozen and a "frosted" window is the result.

Outside air at zero can carry up to ½ grain of moisture per cubic foot before it begins to precipitate. At 70° F. it can hold 8 grains per cubic foot or 16 times as much. Outside air at zero, however, is never found saturated, its usual "relative humidity" or per cent of saturation being about 50%. Therefore, every cubic foot coming into the building from the outside would carry only ½ grain x 50% or ¼ grain of moisture. This air raised to 70° would still contain ¼ grain of moisture but, since it could carry 8 grains,

its per cent of saturization at 70° is ¼ divided by 8 or 0.03 or 3%. Under normal conditions moisture given off in the breath, vaporization of water within the building, steam leaks and so forth may increase this 3% up to as high as 38% to 50% relative humidity which, at the most, is 8 x 50%, or 4 grains per cubic foot.

To cause this air to precipitate its moisture on the wall the air adjacent to the wall must be cooled to a point where it no longer can contain its 4 grains and this temperature would have to be below 50° F. to produce any precipitation at all and quite a way below 50° to produce the amount described.

For this reason we cannot believe that this condition was due to natural causes. Additional evidence that it was a most abnormal condition is furnished by the fact that "we did not have trouble with any of the other rooms—the conditions were absolutely the same."

As to what was the source of this unusual and excessive humidity the correspondent offers no clue except to say that no steam pipes were in the floor, walls, or ceiling. The only suggestion we see indicated is the fact of steam radiators being in the room. High steam pressure—such as would be used in zero weather—might cause the air valves and valve stems to leak excessively and continuously so as to raise the humidity, a cracked radiator section would do the same thing and, if hand operated pet cocks are used for air relief, the opening of these early in the morning could result in the escape of a large amount of vapor which might condense later as described.

Transmission Factors for Combinations of Different Materials.

EDITOR HEATING AND VENTILATING MAGAZINE:

Permit me to congratulate you upon the step you have taken in your endeavor to bring before the heating profession the data to be presented in the "Standard Data Sheets." I trust you will receive the cooperation of the heating experts which this work deserves.

There are two questions on which I would appreciate having your opinion. On sheet No. 1 it is stated that "the combined resistance of the two is then the sum of the resistance of each and the resistance is the reciprocal of the transmission factor." This is in reference to a wall composed of two different materials. Now, if the above statement is true of two different materials, it should also be true of two walls of the same material.

Let us take, for instance, a 24-in. brick wall which transmits 14 B.T.U. per square foot per hour for a difference in temperature of 70° F., and a 12-in. brick wall which transmits 21.7 B.T.U. under the same conditions, the two together making a 36-in. brick wall. By the same process of reasoning, as mentioned on sheet No. 1, 1/14 + 1/21.7 = 35.7 ÷ 304 = 0.117, the reciprocal of which is 8.5, which should be the number of B.T.U. transmitted by a 36-in. brick wall under the conditions as above mentioned. You will notice, however, that in the tables on sheet No. 1A the factor for a 36-in. brick wall for these conditions is 11.2 B.T.U. You will also notice that the same inconsistency exists for any other combination of walls of the same materials.

The second question relates to information on sheet No. 1A where you have given values showing that a brick wall plastered on one side will transmit more heat than a plain brick wall. If you apply the same reasoning in this case as mentioned on sheet No. 1, considering a wall of two different materials, you are bound to get a smaller factor for the combination of brick and plaster than you have for plain brick. The factor I have always used for plaster 1-in. thick is 49 B.T.U. per square foot per hour for a difference of 70°. If you are willing to accept this as being somewhere near the correct factor, then the factor for a 12-in. brick wall would be the reciprocal of 1/21.7 + 1/49 = 70.7 ÷ 1063.3 = 15.

I trust that you will consider these criticisms as constructive rather than adverse, for I assure you my object is only to help.

P.

Pittsburgh, Pa.

Our correspondent has raised a very interesting question in his inquiry as to why the sum of the resistance factors of a 12-in. and 24-in. brick wall does not equal the resistance factor of a 36-in. brick wall. This is the kind of question we want our readers to ask and we hope for further discussion on the subject by other subscribers if our explanation does not entirely make clear the point in question.

As our correspondent says, we stated that the equation would hold true for two different substances and his reasoning that it should also hold true of two similar substances is quite logical. In the case, however, of two similar substances a *combination* is *not* being made and the *thickness only* is being increased. Now the formula for any thickness of wall with a loss of "X" would be 1/X plus 1/X when the thickness is doubled or 2/X which, changed

back to the transmission factor, is X/2 or one-half of the transmission of the original wall. Now this is not true as doubling the thickness of a wall *will not* and *cannot* cut its loss in half. This is easily seen by reference to any table of heat losses.

This is because the loss of heat through a wall takes place in three ways—by leakage, by radiation and by convection. Convection is the heat carried off by the circulation of air against the face of the wall and radiation is the heat projected out from the wall to surrounding objects without regard to the air loss. The whole loss is in turn governed by the "conduction" factor which is the property of transmitting heat through the wall itself—from one surface to the other—by the contact of the particles of the wall with each other.

Increasing the thickness of a wall affects the conduction factor *but* a wall of double thickness has the same amount of exposed radiating surface and the same amount of exposed convection surface per square foot as a wall of only half the thickness. Therefore *if the conduction factor were not cut* down by the increase of thickness the loss for all thicknesses would be the same, per square foot per degree. The cutting down of the transmission factor however *does* produce a lesser heat loss *only* by lowering the temperature of the outside wall surface and to this extent only is the loss reduced by increasing the thickness.

It is also pertinent to note that no formula can give results which check absolutely with actual tests since the tests do not even check with each other and for a more accurate method and fuller description of the action of wall transmission the correspondent is referred to a very able paper by L. A. Harding read before The American Society of Heating and Ventilating Engineers at its nineteenth annual meeting in which this subject is treated with greater detail than we could find room to do here.

It is believed that the formula as we gave it is the simplest, easiest to remember, and as reasonably accurate for the purpose which we recommended, as any procurable. It is also desired to call our readers' attention to the fact that wall factors for practical use are not necessarily required to be of great refinement, as explained briefly in the second paragraph of Standard Data Sheet No. 1.

In regard to the second question, this point has already been raised by several other readers and again we can only repeat that the formula may not check to the second decimal place with the result of actual tests any more than the tests themselves check, one with the other.

Professor R. C. Carpenter Retires from Cornell University.

Professor R. C. Carpenter, head of the department of experimental engineering in the Sibley College of Mechanical Engineering, Cornell University, reaches the retiring age at the end of the present college year and will sever his connection with Cornell University at that time.

Respecting his retirement, the committee on general administration of the Board of Trustees, adopted the following resolution:

"*Resolved*, That the trustees in accepting the resignation of Professor Carpenter express their high appreciation of his services to the university for nearly thirty years. As a pioneer in the field of experimental engineering he is held in the highest esteem by all mechanical engineers, and by his writings in this field he has made an assured place for himself in the annals of his profession. As a teacher and investigator he is affectionately remembered by many generations of students and his retirement from the faculty of Sibley College will be viewed with great regret by all his colleagues."

It is Professor Carpenter's intention to continue his residence in Ithaca. He retires in good health and expects to maintain his activities in the fields of engineering investigation and research for several years to come.

As author of "Heating and Ventilating Buildings," now in its sixth edition, and through a vast amount of research work, much of which was directly connected with the art of heating and ventilation, Professor Carpenter has long occupied a commanding position in the profession. His many friends will join in congratulating him on the successful completion of his college services and in wishes for his continued health and success.

German Measures for Safeguarding the Fuel Supply.

According to a report from the Havas correspondent at Geneva, Switzerland, the Berlin city government decreed that on account of the lack of freight cars and the impossibility of obtaining sufficient supplies of coal, houses which are served from central heating plants must not have a temperature of more than 59° F. All central heating plants were to cease operation March 31. Hot water supplied by the city to apartments was to be cut off immediately.

NEW DEVICES

New Straight-Way Type St. John Steam Meter.

A new "straight-way" type St. John indicating and recording steam meter has recently been placed on the market by the American District Steam Co., North Tonawanda, N. Y. This device is equally adaptable for measuring the flow of saturated or superheated steam, and is especially useful in measuring the quantity of steam used in the operation of engines, pumps, blowers, laundries, steam kettles, heating systems or drying rooms and other steam purposes. This meter is designed to measure the flow of steam at all pressures and under varying loads. Its usefulness to the seller and purchaser of steam is enhanced by its recording feature which shows, in chart form, a complete and continuous record of the steam used.

The only moving part of this meter is the valve and spindle which floats in the current of steam, the vertical movement of which is transferred to the pointer indicating in horse power the quantity of steam flowing. At the same time, the brass pencil, the movement of which is identical with the pointer, records on a metallic-treated paper ribbon, operated by clock work at a speed of ½-in. per hour. Therefore each day's record is recorded on 12 in. of the ribbon. The vertical movement of the valve and spindle is proportionate to the quantity of steam flowing, the movement of pointer and recording pencil being reduced somewhat by the arms mounted on spindle (0), as shown in the illustration (Fig. 2).

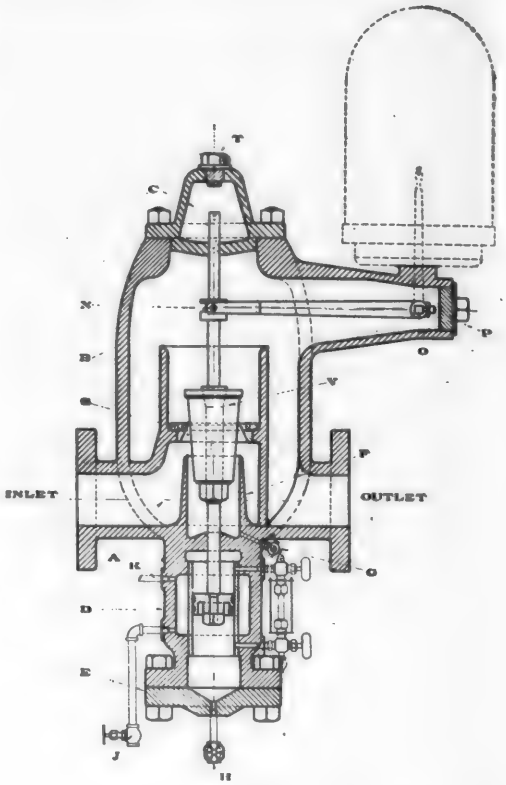
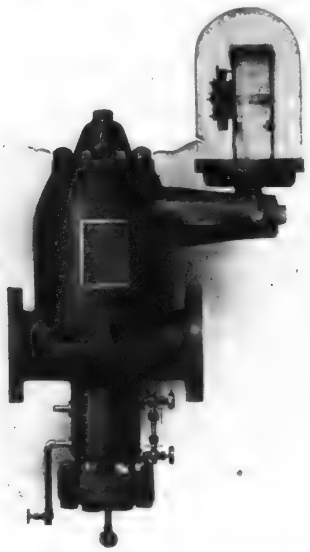


FIG. 2—CROSS-SECTION OF ST. JOHN METER.

The principle on which the St. John meter operates is that with a uniform difference of pressure on two sides of an orifice through which steam is flowing, with a constant initial pressure, the quantity passing bears a direct relation to the area of the orifice. The valve, or plug, is so tapered that the area of the orifice is increased in direct proportion to the rise of the valve, the weight of which is constant and requires a difference of pressure of about 2 lbs. to raise it from the seat, so the greater the steam demand the higher the valve floats, and its movement is recorded on the paper chart in the manner mentioned.

The operation of the meter is as follows: Steam enters the body of the meter (A) on the under side of the valve (V), and raising the valve—the height of which is governed by the quantity of steam flowing—passes to the outlet chamber (B). In the cross-section (S) is a Monel metal seat screwed into the portion of the casing



NEW TYPE OF ST. JOHN STEAM METER.

which separates the spaces (A) and (B). (V) is the special bronze valve having a nickle steel spindle. This valve, when at its lowest position, fits closely in or on the Monel metal seat, thus shutting off entirely the flow of steam. As the tapered valve rises, the space between it and the Monel metal seat is the annular orifice through which the steam flows and increases to maximum when the valve is at the highest position, the rate of increase depending on the taper of the valve.

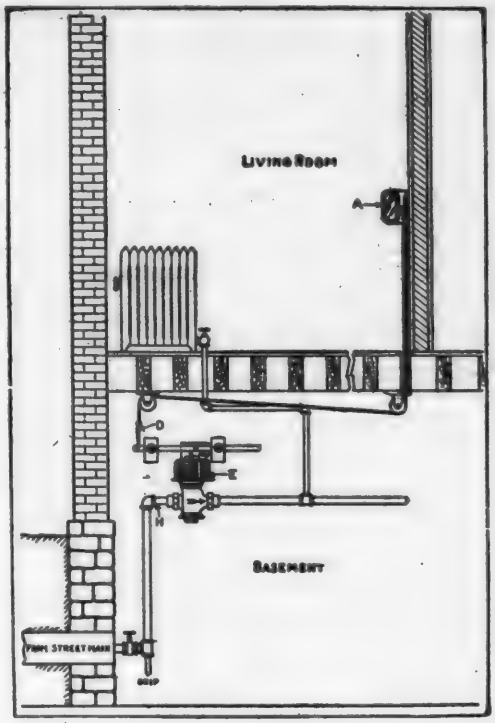
The movement of the valve is transferred to the pencil arm and thence to the chart through the spindle (0). In a recent bulletin, devoted to this new design of the St. John meter, are given full directions for calculating the quantity of steam used from the data given on the chart, as well as a detailed description of the meter itself. It is made in ten sizes, from 1-in. to 6-in. and with capacities, at 100 lbs. pressure, ranging from 27 B.H.P. to 1,000 B.H.P.

Controlling the Temperature with Central Station Heat.

The growth of the central station method of heating is bringing an increasing demand for effective means of regulating the temperature in buildings so supplied because, otherwise, the only way for the operator to regulate the temperature is by opening or closing the radiator valve or, when the rooms become overheated, opening the windows.

A successful method for maintaining an even temperature under such conditions is provided by the Ideal Sylphon regitherm operated in connection with the Ideal Sylphon reducing valve. The regitherm is placed in the living room and is connected

IDEAL SYLPHON REGITHERM.



REGITHERM AND REDUCING VALVE ON CITY STEAM MAIN.

by a small wire cable to the reducing valve in the supply pipe, where it enters the basement from the street. When the room temperature becomes higher or lower than the point desired, the regitherm slightly closes or opens the reducing valve. This arrangement provides for just enough steam in the radiators to keep the rooms at the desired temperature.

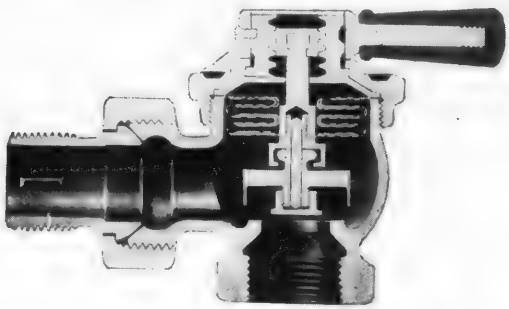
Following is the record of a two-weeks' test in a 10-room house at Overbrook, Pa., showing the economy possible with regitherm control over hand control. With practically the same outdoor temperature, the indoor temperatures, with hand control, ran from 65° to 80° F. in the daytime and from 45° to 70° F. at night, with regitherm control the temperature was maintained steadily at 70° in the daytime and at 60° at night. The average amount of water condensed per day, with hand control, was 1,500 lbs., and, with regitherm control, 1,300 lbs. From this it will be seen that there was a saving of 50c per 1,000 lbs., or 38 cents per day.

The regitherm is made entirely of metal. It can be set for any temperature from 60° to 80° F. and, it is stated, requires no attention at any time. There are no delicate parts or motors. This apparatus is manufactured by the American Radiator Co., Chicago, Ill.

The Dunham Radiator Trap in Central Station Heating.

The merit of central station heating is enhanced by high radiator efficiency. Any device that will aid in developing the highest efficiency in the radiation is a boon to this particular class of heating.

Among the radiator traps that possess notable advantages for this class of service, the Dunham trap, which is manufactured by the C. A. Dunham Co., Marshalltown, Ia., is a good example. It has the advantage, among others, of being simple in design. At the same time it is positive

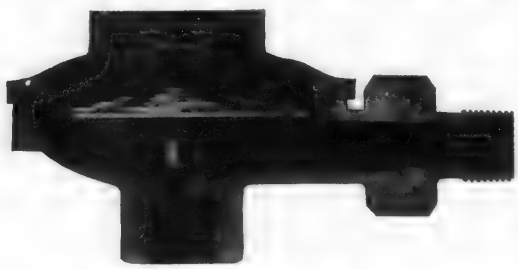


SECTIONAL VIEW OF DUNHAM PACKLESS INLET VALVE.

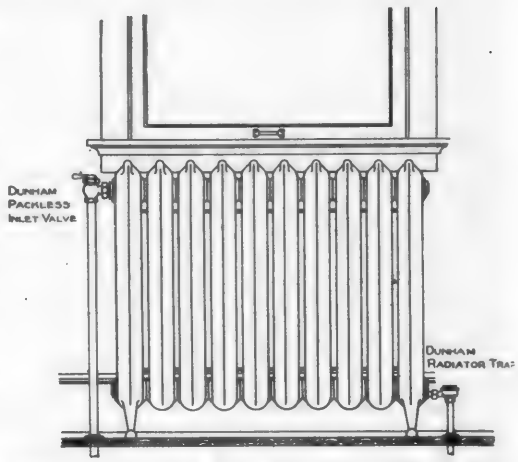
in action, has its working member open to the conditions which exist in the radiator and is thus subject to them and automatically controlled by them, so that the radiator is constantly relieved of air and water, while steam is held in the radiator to perform its maximum work.

The Dunham trap consists of a body, a cover and the thermostatic disc which is secured in the cover. There are no loose parts, no sliding contacts and no guide or obstruction in the valve opening. It has a flat self-cleaning valve of unusually large area.

The Dunham packless inlet valve, shown in the accompanying illustration, is a fitting companion to the trap described. It is free from springs and packing of any sort. It is also a quick-opening valve. It is made only in angle pattern for use in



SECTIONAL VIEW, DUNHAM RADIATOR TRAP.



ARRANGEMENT OF SUPPLY AND RETURN CONNECTIONS TO RADIATOR WITH CENTRAL STATION SERVICE, OPERATING ON DUNHAM SYSTEM.

a top inlet connection to the radiator. One noticeable feature is its low bonnet and steam; it does not project above the top of the radiator.

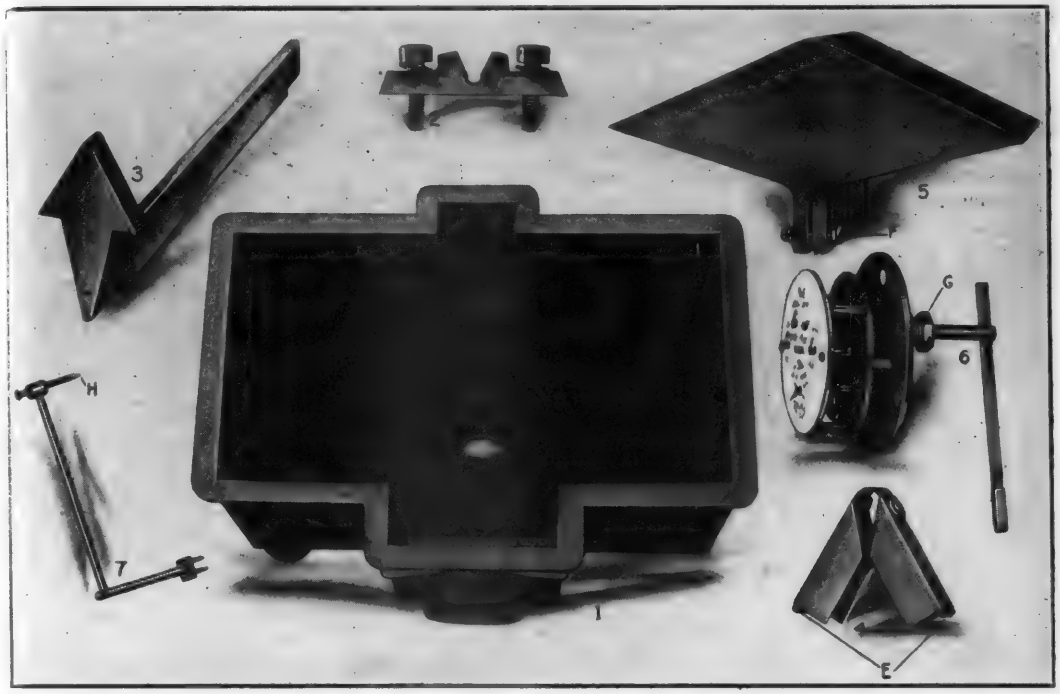
In central station heating service, the Dunham radiator trap and packless inlet valve are always installed as shown in Fig. 3.

Construction of the Mason Condensation Meter.

The successful showing made in recent tests by the Mason condensation meter has aroused considerable interest in its construction details, which are shown herewith. The meter itself is reproduced on page 91. This meter was designed by Gilmore Mason, superintendent of the uptown system of the New York Steam Company, 105 East 63rd Street, New York, and has been on the market for about a year. Previous to that, however, a number of experimental installations were made, notably in the Riding Club Building and lately at the Stuyvesant High School, where the meter was operated in connection with a boiler test made under the direction of the New York Department of Education.

As will be seen from the illustration, the meter is notable for its simplicity, both in its parts and in its operation. The particular feature of locating original adjustments with an adjusting key is considered of unusual importance, as it is thus possible to avoid the customary overhauling and testing.

The Mason meter will shortly be manufactured on a large scale as it has already more than fulfilled the expectations of the designer. It embodies the results of Mr.



PARTS OF THE MASON CONDENSATION METER.

1—Cast-iron body. A, B, C, D—water deflectors.
2—Bronze bearings—two per set.
3—Bronze shaft.
4—Shock absorbing cap. E, shock absorbers.
5—Aluminum dumping bucket. F—bolt for shaft connections, two per set.
6—Counter. G—stuffing box.
7—Bronze adjusting key. H—adjusting pointer.

Mason's long experience in connection with meter testing and is based on his efforts to perfect a design requiring the minimum in meter maintenance.

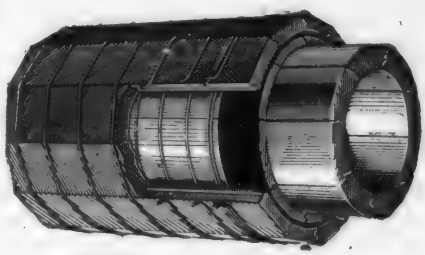
Its principal features consist of (1) the inlet tank, consisting of water and sediment deflector; (2) outside access to adjusting screws; (3) simple operation of locating the original adjustment points, made possible by the use of an adjusting key which is connected to the bucket shaft by inserting the key through the opening immediately under the counter housing; (4) the arrangement of the water deflectors on the inner side of the bottom of the meter casing which causes a splash of water over the bearings during each discharge of the dumping buckets thus lubricating the bearings without grease or oil: and (5) the three bosses projecting from the bottom of the casing and tapped for 1¼-in. nipples, affording the major portion of a shelf or stand to support the meter body.

Wyckoff's Improved Steam Pipe Casing.

The latest type of pipe casing to be brought out by A. Wyckoff & Son, Elmira, N. Y., is illustrated herewith. It is made of cypress, the imperishable qualities of which have made it known as "the wood eternal." The casing is made up of two shells of cypress, the inner shell being 2 in. thick and the outer shell 1 in. thick. Both shells are spirally wound with heavy, galvanized steel wire. Between the shells is an annular air space ¼-in. thick. This separation is maintained, and the air made dead, by wrappings of asphaltum packing strips, each 4 in. wide at the ends of the casing. The wire wrappings in each case are drawn sufficiently tight to make the joints wholly water-proof.

The completed covering thus consists of two shells, with an air space between, making a non-conducting casing which offers great resistance to the radiation of heat.

This covering is made in lengths from 4 ft. to 12 ft., connected by a driving fit

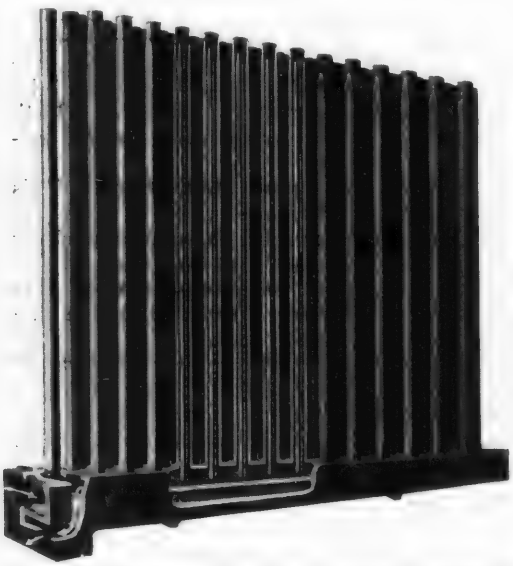


IMPROVED TYPE OF WYCKOFF STEAM PIPE CASING.

tenon and socket joint. The inner tube of the casing is lined with tin, when used on pipes which are subjected to more than 5 lbs. steam pressure. The manufacturers have recently published a pamphlet giving full details regarding the Wyckoff improved pipe casing which may be had on request by those interested.

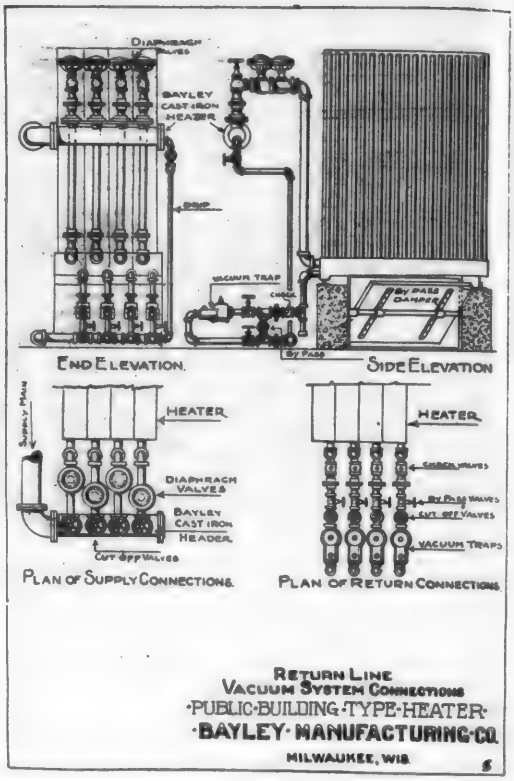
Trade Literature.

CHINOOK HEATERS, for indirect heating work, made by the Bayley Mfg. Co., Milwaukee, Wis., are the subject of a new engineering catalogue that constitutes a valuable addition to engineering literature. Carefully-compiled tables are given covering heating surface, free areas, dimensions and weights. Another series of tables covers final temperatures and condensations with steam at various pressures, ranging from zero pressure up to 125 lbs. from — 40° temperature of entering air up to 70°. There are 20 tables in this series and the data cover practically any condition that has to be met. Another large section of the catalogue is taken up with details of standard connections of the public-building type heater and the factory-type heater, for a wide variety of uses. Methods of



CONSTRUCTION OF THE BAYLEY CHINOOK INDIRECT HEATER.

computing the required sizes of heaters are also given, the catalogue concluding with some typical photographs of installations. The Bayley automatic steam trap, designed for use in connection with the Bayley heaters and the Bayley Plexiform fan are also shown and described. Size 8 x 10¾ in. Pp. 72.



RELIABLE EVIDENCE, presenting an imposing array of buildings equipped with the Reliable vacuum and vacu-vapor systems of heating, is the subject of a cloth-covered book that is being called afresh to the attention of the trade by the Bishop-Babcock-Becker Co., Cleveland, O. Several series of pages are given up to installations in different classes of buildings. For instance, office buildings equipped with the Reliable systems take up four pages; while bank buildings, government and public buildings, schools and colleges, theatres, clubs and associations, churches, hospitals and sanitariums, store buildings, factories and warehouses, hotels, apartment buildings, and residences are given equal prominence. The final pages of the book are given up to a description with cuts, showing the construction features of the Reliable VacUstat, which is a thermostatic valve used on air line vacuum heating systems; the vacu-traps, heavy brass thermostatic valves used on return line vacuum heating systems; the Vacu-Graduate packless radiator valves, used on Reliable vacu-vapor heating systems, and the Reliable vacuum pump, electric or hydraulic, made in various sizes with different capacities. Size 8 x 11 in. Pp. 48.

Central Station Heating Notes.

Frankfort, Ind.—Frankfort citizens are opposing a proposed increase in the heating rates of the Frankfort Heating Company on the ground that there is an unnecessary loss of heat in the company's mains. The matter is now before the Indiana Public Service Commission. It was thought possible that extensive repairs in the insulation of the mains will be made.

Goshen, Ind.—The *Goshen Democrat* is agitating the proposition of establishing a central station heating plant in that place.

Youngstown, O.—Typical difficulties experienced by many district heating companies during the past winter were recounted by Harry Engle, secretary and treasurer of the Mahoning Valley Lighting Company in explaining the causes for the unsatisfactory heating of the Rayen School, which is supplied from the company's mains. Mr. Engle explained that the plant was first put out of commission by the corrosion of the boilers due to acids in the river. The next trouble, which developed soon after the first of the year, was due to inability to get coal, when all the plants in that locality suffered from the same trouble. The next breakdown was caused by an accident to the coal conveyor, Mr. Engle stating that the scarcity of coal made it necessary to use a larger size than the conveyor was designed to handle. The final accident was a breakdown of the fan furnishing forced draft for the largest boiler.

Cleveland, O.—The proposed extension of the municipal steam heating plant to give service to practically all the homes in Cleveland, which was the purpose of an ordinance introduced in the council recently by Councilman Sulzmann, is not favored by Commissioner of Heat and Light Davis, who stated that he would make an adverse report on the proposition. According to the plan proposed, the city heating plant was to have its system extended in connection with the $3,000,000 pragramme for street improvements. Mr. Davis stated that the city lost $50,000 last year on what heat it now manufactures. "With the coal cost soaring," he added, "we will probably lose much more this year."

Danville, Ill.—In connection with the repaving of West Main Street, business men and property owners have asked the council to start mandamus proceedings to compel the extension of the steam heating lines on West Main Street, from Clark Street west to Gilbert Street. It was first planned to circulate a petition to this effect, but it was felt that quicker action could be secured through mandamus proceedings.

Louisville, Ky.—The City of Louisville has won its case against the Kentucky Heating Company for back taxes on its franchise, running back to 1912. The amount of the judgment, as adjudged by the Court of Appeals, is $26,648. The court held that the action of the Board of Equalization of Louisville, in assessing the company's franchise at $1,500,000, was a final action. The court also stated that it could not recall any case where the right is given to the court to review the assessment of a city board whose action is prescribed by the statute to be final. The whole question in this case was whether the board had the authority to make a final assessment of the franchise of the company. The heating company, which is now a part of the Louisville Gas & Electric Co., claimed that its franchise expired in 1908, and that it could not be held liable for the right to operate after the expiration of the franchise. The city contended that the tax was against tangible property held by the company and not on the right to operate.

Wataga, Ill.—The *Wataga Visitor* states that a number of business men of Watseka are planning to install a large heating plant in the rear of their buildings for heating the business district. Dissatisfaction with the operation of the city heating plant is given as the reason for the movement.

Davenport, Ia.—The city council has granted the petition of the People's Light Company, asking that the heating franchise held by the Davenport Gas & Electric Company be transferred to the first-named concern.

New Ulm, Minn.—In a report made to the city council on the operation of the municipal heating plant of the New Ulm Heating Company, it was stated that meters were installed early in January and it was desired that the council concur in fixing the rate for the steam consumed during the time previous when the plant was operated without meters. There are at present 31 consumers and the January income was $1,280. The company thought that a 25% reduction from the heat used during the month of January would be a just settlement to the city and to the consumers for the heat used during December. The company also considered that 50% of the heat used during January would be an equitable adjustment for the heat used during November. On this basis, which was endorsed by the council, the estimated income for December was $870 and, for November, $349. No charge was made for heat used during the latter part of October. A board of managers was appointed to have general charge of the heating company, consisting of two directors of the company,

F. W. Johnson and A. J. Vogel, and two members of the city council, Councilmen Hamann and Krook.

Minneapolis, Minn.—The Minneapolis Steam Company is being organized and has applied for a franchise to pipe steam through the streets of the city. The project has aroused considerable interest on the part of the civic organizations of the city. At a meeting of the Minneapolis Civic Improvement Association, a letter was read from H. C. Kimbrough, Western manager of the American District Steam Company, explaining the company's proposition. It is expected that a number of public hearings will be arranged before definite action is taken.

Des Moines. Ia.—The heating franchise asked for by the Des Moines Electric Company has been favorably acted upon by the city council and March 26 was set as the date for a special election on the proposition. The Des Moines Electric Company and the city were each to bear half the cost.

Price, Utah.—A proposal has been made by J. H. Manson to the city council of Price to operate the local municipal light plant for 25 years and as rental to pay off the $25,000 bonds with interest. In addition Mr. Manson asks a franchise for the laying of steam pipes in the business district of Price for supplying heat to business blocks and other buildings, including the court house, school house and tabernacle.

Salt Lake City, Utah.—The franchise asked for by the Utah Power & Light Company for the establishment and maintenance of a central heating plant has been granted by the city commission. The franchise is dual in form, being really two franchises. By one, permission is granted to establish a steam heating plant and give service to any part of the city. By the other, the privileges as to heating service formerly held by the Utah Light & Traction Company are transferred to the Utah Power & Light Company. The purpose of the power company is to engage in the furnishing of steam heat over as wide an extent of the city as may practicable. To this end various heating plants in the business district will be connected and unified with those already operated in conjunction under the old franchise of the Utah Light & Traction Company. One of the first moves to this end was the purchase by the Utah Power & Light Company of the power plant of the two large Newhouse buildings—the Newhouse and the Boston—which recently changed hands. This plant served these two buildings, as well as the Newhouse Hotel, the Commercial Club and other adjoining buildings. The power company is planning to make the Church heating plant the center of its heating system, with the Newhouse plant as an auxiliary. A 20-in. main will be laid south through the center of the blocks, between Main and West Temple Streets, from South Temple to the Kearns Building and thence to the Newhouse Hotel, thence east to the auxiliary plant and north through the centers of the blocks between Main and State Streets to South Temple Street, forming a rectangle. These mains will act as feeders for branches in various directions. Mayor Ferry was authorized to enter into a 10-year contract with the power company for power to operate the pumping plant at Utah Lake, in which the city is interested.

Standard Heating and Ventilating Data Sheets.

Previously-published data sheets, similar to those appearing on Pages 59-63 of the present issue, are as follows:

FEBRUARY, 1917, ISSUE.

No. 1—B.T.U. Losses.
No. 1-A—B.T.U. Losses—Brick.
No. 1-B—B.T.U. Losses—Stone and Concrete.
No. 1-C—B.T.U. Losses—Combinations.

MARCH, 1917, ISSUE.

No. 1-D—B.T.U. Losses—Tile.
No. 1-E—B.T.U. Losses—Frame Construction.
No. 1-F—B.T.U. Losses—Glass, Skylight and Miscellaneous.
No. 1-G—B.T.U. Losses—Ceiling, Floor and Roof.

Copies of these sheets, printed, separately, on one side only, may be obtained at 5 cents each. The attention of readers is also called to the special binder for holding these sheets, which is now ready. The price of the binder is $1.00, postpaid.

Harrison W. Craver, chief librarian of the Carnegie Library of Pittsburgh since 1908, has tendered his resignation to accept a position as director of the library of the United Engineering Societies of New York. The United Engineering Societies library is now believed to be the largest engineering library in the world, with approximately 150,000 volumes on technological subjects on its shelves.

EXPOSURE.

The exposure factor is closely allied to the leakage factor inasmuch as the exposure factor usually covers a greater percentage than the simple difference in outside air temperature would produce. In proof of this it is a generally accepted fact that the outside air on the south side of a building will average about 10 degrees warmer than on the north side during the day. Yet many methods of computing radiation involve an increase of 25% to 33 1/3% for north exposure.

For well-constructed buildings in locations of only reasonable exposure the additional allowance for exposure should be made as follows:

	Unventilated Rooms.	*Ventilated Rooms.*
South	0%	10%
East	10%	20%
West	10%	20%
North	15%	25%

For badly exposed buildings a larger allowance for exposure should be made as follows:

	Unventilated Rooms.	*Ventilated Rooms.*
South	10%	20%
East	20%	30%
West	20%	30%
North	25%	35%

The reason for allowing a little higher exposure factor in the ventilated rooms is that such rooms have no leakage figured (as is explained under "Leakage") and, on windy days when the room is on the windward side, the cold air may rush in around the windows to a discomforting degree unless some little additional surface is provided.

On the other hand, in an unventilated room leakage for a complete change of air every hour is figured and this is sufficient to care for all ordinary contingencies.

LEAKAGE.

Leakage is the most variable quantity with which the designer of a heating plant has to deal. At the time a heating system is designed it is to a great extent a gamble on what the final construction of a building will be, and many contemplated helps to the heating of a building may later be abandoned in order to cheapen up the cost. Metal sash, weather-strips, double windows, etc., may never finally be used, however positively they may at first be specified, and too much dependence must not be placed on such aids.

In the ordinary, well-constructed building the figuring of *one air change per hour* for leakage in all unventilated rooms and spaces will be entirely sufficient. This has been proven time and again in practical experience and, while at certain widely-separated times the leakage may exceed this, these periods are of such short duration that there is enough leeway on the amount of surface installed to carry over such a brief time without any serious discomfort.

B.T.U. REQUIRED PER CUBIC FOOT FOR VARIOUS AIR CHANGES AND TEMPERATURE RANGES.

Temp. Rise Degrees Fahr.	No. of Air Changes per Hour								
	½	1	1½	2	3	4	5	6	10
5	0.05	0.09	0.14	0.18	0.27	0.36	0.45	0.55	0.91
10	0.09	0.18	0.27	0.36	0.55	0.73	0.91	1.09	1.82
15	0.14	0.27	0.41	0.55	0.82	1.09	1.36	1.64	2.73
20	0.18	0.36	0.55	0.73	1.09	1.45	1.82	2.18	3.64
25	0.23	0.45	0.68	0.91	1.36	1.82	2.27	2.73	4.55
30	0.27	0.55	0.82	1.09	1.64	2.18	2.73	3.27	5.45
35	0.32	0.64	0.95	1.27	1.91	2.55	3.18	3.82	6.36
40	0.36	0.73	1.09	1.45	2.18	2.91	3.64	4.36	7.27
45	0.41	0.82	1.23	1.64	2.45	3.27	4.09	4.91	8.18
50	0.45	0.91	1.36	1.82	2.72	3.64	4.55	5.45	9.09
55	0.50	1.00	1.50	2.00	3.00	4.00	5.00	6.00	10.00
60	0.55	1.09	1.64	2.18	3.27	4.36	5.45	6.55	10.91
65	0.59	1.18	1.77	2.36	3.54	4.72	5.91	7.09	11.82
70	0.64	1.27	1.91	2.54	3.82	5.09	6.36	7.64	12.72
75	0.68	1.36	2.05	2.73	4.09	5.45	6.82	8.18	13.63
80	0.73	1.45	2.18	2.91	4.36	5.82	7.27	8.72	14.54
85	0.77	1.55	2.32	3.09	4.64	6.17	7.73	9.27	15.45
90	0.82	1.64	2.46	3.27	4.91	6.55	8.18	9.83	16.36

Note—This table based on 1 B.T.U. raising 55 cu. ft. of air 1° F.

Example:

A room 14 ft. x 14 ft. x 10 ft. has a radiation loss of 5,000 B.T.U. and a leakage loss estimated at 1½ changes per hour with outside air 10° F., and inside temperature of 70° F. This is a temperature rise of 70° — 10° = 60°.

In the table, under 1½ air changes and opposite 60°, is found the factor 1.64. The cubic contents, 14 x 14 x 10 or 1960 cu. ft. x 1.64 = 3214 B.T.U. for leakage.

Total loss = 5000 + 3214 = 8214 B.T.U.

TEMPERATURE RANGE.

A building in a given locality is subject to certain environments which have much to do in deciding its heating requirements.

It may be exposed to cold winds and set on a prominent elevation or it may be in a sheltered position and protected by hills, forests, or other nearby buildings.

The temperature range in a given locality may be extreme for long and continuous periods of time or it may reach an extreme but rarely and, then, for a brief interval of hours only.

A locality which goes down to zero only once in two or three years and which has the zero weather last only a half a day or less can safely be figured for 5° or even 10° above zero. But for a locality which goes down to 5° above and then hovers around such a temperature for a week or more it would be much wiser to figure it at zero.

LOWEST TEMPERATURES IN THE UNITED STATES.

State and City	Lowest Temp. Degrees Fahr.	State and City	Lowest Temp. Degrees Fahr.
Alabama		*Georgia*	
Birmingham	2	Augusta	3
Mobile	—1	Atlanta	—8
Montgomery	—5	Savannah	8
Arizona		*Idaho*	
Flagstaff	—17	Boise	—28
Phoenix	12	Lewiston	—18
Yuma	22	Pocatello	—20
Arkansas		*Illinois*	
Fort Smith	—15	Cairo	—16
Little Rock	—12	Chicago	—23
California		Springfield	—22
Fresno	20	*Indiana*	
Independence	10	Indianapolis	—25
Los Angeles	28	Evansville	—15
Sacramento	19	*Iowa*	
San Diego	32	Des Moines	—30
San Francisco	29	Dubuque	—32
Colorado		Keokuk	—24
Denver	—29	Sioux City	—3
Grand Junction	—16	*Kansas*	
Pueblo	—27	Concordia	—25
Connecticut		Ft. Dodge	—26
Hartford	—14	Wichita	—22
New Haven	—14	*Kentucky*	
Southington	—19	Louisville	—20
District of Col.		*Louisiana*	
Washington	—15	New Orleans	7
Florida		Shreveport	—5
Jackson	10	*Maine*	
Key West	41	Eastport	—21
Pensacola	7	Portland	—17
Tampa	19	*Maryland*	
		Baltimore	—7

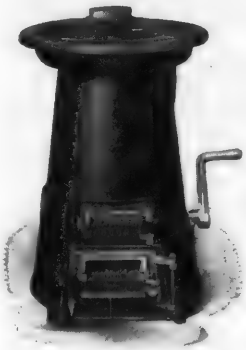
THE HEATING AND VENTILATING MAGAZINE — 1123 BROADWAY — N. Y. CITY.

LOWEST TEMPERATURE IN THE UNITED STATES.

State and City	Lowest Temp. Degrees Fahr.
Massachusetts	
Boston	—13
Michigan	
Alpena	—27
Detroit	—24
Marquette	—27
Pt. Huron	—25
Minnesota	
Duluth	—41
Minneapolis	—33
Moorhead	—48
St. Paul	—41
Mississippi	
Meridian	—6
Vicksburg	—1
Missouri	
Hannibal	—20
Kansas City	—22
St. Louis	—22
Springfield	—29
Montana	
Havre	—55
Helena	—42
Kalispell	—28
Miles City	—49
Nebraska	
North Platte	—35
Lincoln	—26
Omaha	—32
Valentine	—38
Nevada	
Carson City	—22
New Hampshire	
Concord	—35
New Jersey	
Atlantic City	—7
Cape May	—7
New Mexico	
Roswell	—18
Santa Fe	—13
New York	
Albany	—24
Binghamton	—26
Buffalo	—14
New York	—6
Oswego	—23
Saranac Lake	—38
North Carolina	
Charlotte	—5
Hatteras	8
Wilmington	5
North Dakota	
Devils Lake	—51
Bismarck	—44
Williston	—49

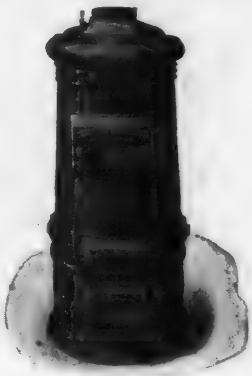
State and City	Lowest Temp. Degrees Fahr.
Ohio	
Cincinnati	—17
Columbus	—20
Toledo	—16
Oklahoma	
Oklahoma	—17
Oregon	
Baker City	—20
Portland	—2
Roseburg	—6
Pennsylvania	
Erie	—16
Philadelphia	—6
Pittsburgh	—20
Rhode Island	
Providence	—12
Block Island	—4
South Carolina	
Charleston	7
Columbia	2
South Dakota	
Huron	—43
Pierre	—40
Yankton	—32
Tennessee	
Chattanooga	—10
Knoxville	—16
Memphis	—9
Nashville	—13
Texas	
Amarillo	—16
Corpus Christi	—11
El Paso	—5
Ft. Worth	—8
Galveston	8
San Antonio	4
Utah	
Salt Lake City	—20
Vermont	
Burlington	—25
Northfield	—32
Virginia	
Lynchburg	—6
Norfolk	2
Washington	
Seattle	12
Spokane	—30
Walla Walla	—17
West Virginia	
Elkins	—21
Parkersburg	—27
Wisconsin	
La Crosse	—43
Milwaukee	—25
Wyoming	
Cheyenne	—38
Lander	—36

Start spring business



No. 10 Ideal Arco

The need for a hot water supply after the heating boiler, with its coil, has been shut down, will soon confront many house-owners. Why not start right now to secure additional business by looking up those for whom you installed heating plants last fall and advising them, as well as all inquirers, to put in an



No. A-12 Ideal Junior

IDEAL Hot Water Supply Boiler

The steady reliability of a hot water supply from one of these small boilers is one of the comforts which makes an owner feel that his home is just a little bit the most satisfactory home in the world.

No. 152 Ideal Premier

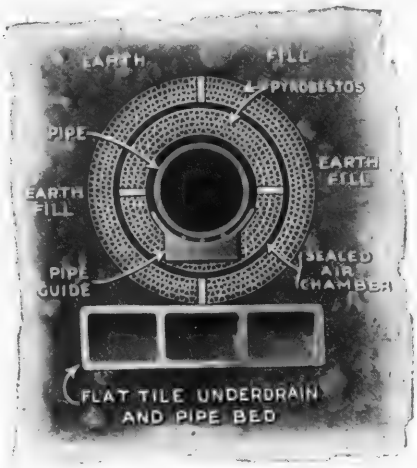
Their low first cost and the mere nominal expense of upkeep, as pointed out by all enterprising contractors, will appeal to the frugality of the average house-owner. IDEAL Hot Water Supply Boilers add to the comfort of living and reduce the high cost of living.

No. 1-D Ideal Laundry

For easy computations of sizes, ratings, etc., see special tables and other information on IDEAL Hot Water Supply Boilers in the "Ideal Fitter."

AMERICAN RADIATOR COMPANY

PYRO-BESTOS



UNDERGROUND PIPE INSULATION

For piping from central heating or power station to detached buildings of Universities, Asylums, Hospitals, Factories, etc. Also as underground Pipe Conduit for heating private Auto garages direct from House heating system.

Cannot rot or decay nor will it retain moisture to rust and destroy the piping during non-heating season.

Saves most coal, sends heat hotter and to a greater distance and by reason of its advanced common sense method of installation is at the same time a lower cost per foot of pipe covered than any other underground pipe Insulation on the market.

It is distinctly your loss if you lack an intimate acquaintance with

Pyro-Bestos

National Air Cell Covering Co.
HENDERSON ST., South of Grand St.
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TRADE AND MISCELLANEOUS NOTES

Coming Events.

May 21-24, 1917.—Spring meeting of The American Society of Mechanical Engineers, in Cincinnati, O.

June 12-15, 1917.—Ninth annual convention of the National District Heating Association, in Detroit, Mich. Headquarters at the Hotel Pontchartrain. Secretary, D. L. Gaskill, Greenville, O.

June 19-21, 1917.—Thirty-fifth annual convention of the National Association of Master Plumbers at Evansville, Ind. Headquarters at the new Hotel McCurdy.

July 18-20, 1917.—Summer meeting of The American Society of Heating and Ventilating Engineers, in Chicago, Ill.

Deaths.

E. M. Herbert, secretary of the Herbert Boiler Co., Chicago, and a son of President E. M. Herbert of the company, died February 8, at the Henrotin Hospital, following an operation for the fracture of his skull. He was 26 years old. Mr. Herbert was injured by a fall, his death following three days later.

Robert Raitz, founder and senior partner of Robert Raitz & Co., Toledo, O., heating and plumbing contractors, died at his home in that city, February 16, after a long illness. He was 72 years old. Mr. Raitz was one of the early heating and plumbing contractors of Toledo and was formerly in partnership with John Lawrence, whose death occurred about a year ago. He was also active in city affairs and had served as a member of the city council. He retired from active business some time ago.

Miscellaneous Notes.

Grand Rapids, Mich.—An indication of the popular treatment of heating and venti-

NO SCALE

CAN ACCUMULATE IN THE

Alberger Multi-Head Water Heater

Note the spirally-corrugated tube construction, so built that water passing through the tubes does so with a rotary motion. This produces a scouring effect and keeps the tubes free from scale.

"The Heater without the Usual Heater Troubles"

For Hot Water Service for Hotels, Laundries, Office Buildings, Apartment Houses, Hospitals, Factories, etc.

Send for Bulletin 201-H, containing constructive details

ALBERGER HEATER CO., Buffalo, N. Y.

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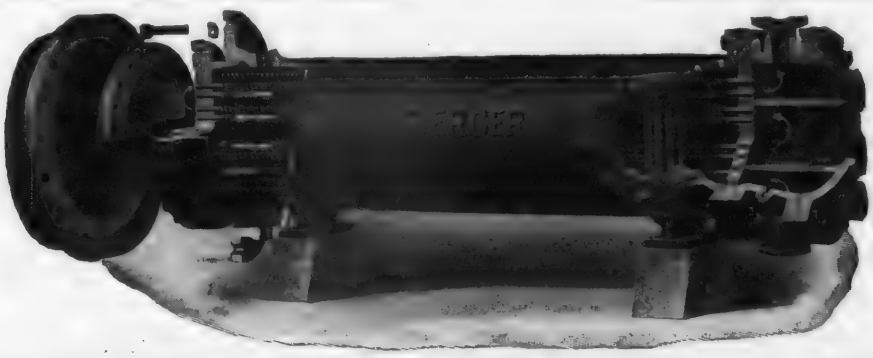


lation is reported from Grand Rapids where recently the city smoke inspector, F. L. Smith, arranged for the following talks on the same evening at the local high school building: "Heating and Smoke Regulation," (illustrated) by Osborn Monnet of Chicago; "Low Pressure Heating," (illustrated) by W. A. Pittsford; and "Domestic Heating and Fuels," by Dwight S. Cole.

Heating Contractors' Association, of Grand Rapids, is the name of a new organization in Grand Rapids, comprising the leading firms engaged in the installation of heating plants. The object of the association is to bring about more uniform and improved methods of installing heating plants. A committee from this association is now working with the fire marshal and ordinance committee in framing a new city ordinance on the subject. The following officers have been elected: President, Harry E. Rhodes; secretary-treasurer, A. H. Shank; directors: Harry E. Rhodes, R. M. De Bruyan, Charles Heth, D. A. Miller and George H. Holwerda.

Chicago, Ill.—A recent compilation of Chicago manufactures shows that the heating, ventilating and plumbing lines rank seventh out of 27 listed. Following is the complete list, with the valuations:

Slaughter and packing	$400,000,000
Foundry products	104,000,000
Agricultural implements	100,000,000
Men's clothing	85,000,000
Printing and publishing	76,000,000
Iron and steel	71,000,000
Plumbing, heating and ventilating lines	46,000,000
Railway cars	35,000,000
Lumber products	32,000,000
Bread and bakery products	28,000,000
Printing	20,000,000
Electrical machinery	20,000,000
Furniture	20,000,000
Soaps	19,000,000
Paints and Varnishes	19,000,000
Tobacco	16,000,000
Hats	15,000,000
Women's clothing	15,000,000
Musical instruments	15,000,000
Tanned leather	13,000,000
Pianos and Organs	12,000,000
Copper, tin and sheet iron products	12,000,000
Confectionery	11,000,000
Ladies' neckwear and fancy goods	10,000,000
Carriages and wagons	6,000,000
Engraving and electrotyping	5,000,000
Gloves	3,500,000

Thorough Heat Distribution

is assured if your clients use a

"RELIABLE" VACUUM OR VACU-VAPOR HEATING SYSTEM

How often have you seen cases where some radiators were hot and others in the same building ice cold? Never—if it was a Reliable Heating System.

With Reliable Air Line and Return Line Systems the radiators are kept free from air by means of an automatic-working vacuum pump, which also pulls steam into the radiators. The Reliable Automatic Radiator Valves permit the withdrawal of the air as fast as it accumulates, but absolutely prevent the loss or escape of steam. Every radiator is forced to do its full duty; and there can be no short circuits.

The three different Reliable Systems—Air Line, Return Line and Vacu-Vapor—cover every steam heating requirement and are equally efficient in any style of building. You provide your clients with most economical and satisfactory heating service when you specify Reliable Equipment.

Our new complete catalog "H V" will prove a valuable addition to your files. Write for your copy, today.

THE BISHOP-BABCOCK-BECKER CO. Cleveland, O.

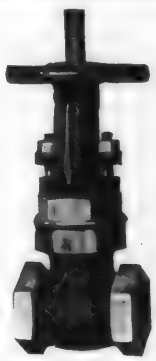
"Zeppelins" of Chicago is the title given to the masses of dense smoke that are frequently seen issuing from the stacks of many of the city's buildings. It is reported that the conditions during the past winter have been aggravated by the lack of hard coal and some of the better grades of soft coal. "We are trying hard," stated Frank A. Chambers, secretary of the Smoke Prevention Association of America, in a recent interview, "to induce building owners to use smoke preventers." At the same time, Dr. E. Vernon Hill, head of the Chicago Division of Ventilation, is contemplating the introduction of an ordinance compelling building owners to install air washers in their ventilating system. "The ventilation experts," he stated, as reported in the *Chicago Tribune*, "are continually preaching the open-window theory. But what is the use of opening your windows when a lot of coal dust will drift in."

Chicago, Ill.—After four years of almost continuous effort, an agreement has been reached with the Chicago Surface Lines whereby they are expending $250,000 for ventilating equipment on their cars. The Chicago Department of Health is now trying to make some arrangements with the elevated railroad companies and expects to arrive at a solution of the difficulty before next winter. According to Commissioner of Health John Dill Robertson, the trouble reported is not so much a matter of operation as it is of equipment. It is a practical impossibility, he states, to maintain satisfactory air conditions in these cars until special devices are installed for the purpose.

Denver, Colo.—Regulation of all warm air heating plants in Denver is proposed in an ordinance introduced in the city council by Councilman Thomas O. Spacy. The ordinance would create a board of examiners of three and provide also for the appointment of an inspector, with a view to the elimination of fire danger, due to poorly-constructed heating plants.

Chicago, Ill.—According to a report of the Boston Finance Commission, whose findings are reported in the *Chicago Herald*, Chicago is surpassed only by Pittsburgh in the amount of money spent by the board of education for janitors and similar employees, while for fuel it is outranked only by Kansas City, Minneapolis and Washington. All comparisons were made on the basis of the number of pupils served. The annual expenditures per child for wages of janitors and other employees for coal and other fuel and for maintenance, repairs and replacements per year are given by the commission as follows:

City	Janitors.	Fuel.	Maintenance.
Baltimore	$2.42	$ .94	$ .48
Boston	3.42	1.34	3.82
Buffalo	3.25	1.54	4.28
Chicago	4.34	1.56	1.95
Cleveland	3.93	1.19	2.97
Detroit	4.18	1.19	1.73



Jenkins Bros. Gate Valves

Distinct in design, accurate in workmanship, interchangeable construction, metal of the best quality. Made in every size and style, in Standard, Medium and Extra Heavy Patterns, with Inside Screw, Stationary Spindle, or Outside Screw and Yoke, Rising Spindle; furnished in cast steel, iron or brass, the latter rough, polished or nickled; with hand wheels of wood, iron or brass.
There's a Jenkins Bros. Gate Valve that will meet your requirements. Consult catalog No. 20.

Jenkins Bros.

New York Boston Philadelphia Chicago Montreal London

STANDARD THERMOMETERS - Indicating and Recording

For VACUUM, STEAM and HOT WATER SYSTEMS, BAKE OVENS and COLD STORAGE PLANTS. SEVEN models of RECORDING and EIGHT of INDICATING Thermometers. All Accurate, Durable and Legible.

Backed by thirty years of Thermometer manufacturing.

They are practically indestructible, are sensitive to changing temperatures and are very easily installed. Supplied with horizontal or vertical extension and standard pipe thread.

Ask for catalog No. 100-107 and trade prices.

STANDARD THERMOMETER COMPANY, 65 Shirley St., Boston, Mass.

Please mention THE HEATING AND VENTILATING MAGAZINE *when you write.*

Kansas City	2.80	1.84	1.00
Los Angeles	2.86	.56	2.65
Minneapolis	3.11	1.61	3.75
Philadelphia	2.80	1.08	1.88
Pittsburgh	4.80	1.43	4.71
St. Louis	3.39	.75	6.40
Washington	2.86	1.66	2.36

For janitor and like service Chicago is credited with paying $1,162,000, while no other city in the list spends half that total. Chicago's fuel bill for the schools is placed in excess of $400,000, while no other city spends $200,000; but in maintenance St. Louis spends $499,000, while Chicago's total for this purpose is only $523,000.

W. H. Hill, vice-president of the American Radiator Co., Chicago, Ill., was elected president of the Chicago Salesmanship Club, recently formed as a local branch of the World's Salesmanship Congress, which held its annual convention recently. 250 salesmen in Chicago have already joined the club.

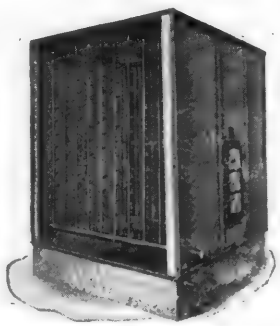
Des Moines, Ia.—A recent car heating bill, introduced in the Iowa legislature, would change the dates between which cars must be heated from April and November to May and October. Another provision is that the conductor and motorman be furnished with enclosed vestibules which must be heated, together with the body of the car, to a temperature of at least 40° F. The bill was up for a hearing recently before the Senate committee on cities.

F. A. Clegg, president of F. A. Clegg & Co., Louisville, Ky., heating and ventilating engineers and contractors, has been elected treasurer of the Louisville Builders' Exchange.

University of Utah announces a course of instruction in heating and ventilating engineering. The course, which is in charge of Professor E. H. Beckstrand is conducted as a lecture and recitation course. It is a requirement for graduation in mechanical engineering, to be taken in the senior year.

Building Operations for January, 1917, for 106 cities, as compiled by The *American Contractor,* show an 11% increase over the same period in 1916. The number of permits was 14,227, as compared with 13,379 for January, 1916. The total figures were $55,910,349, as compared with $50,490,041. A notable gain was reported by Boston of 71%, the figures being $7,375,000, as compared with $4,300,000 a year ago. Other gains were reported by Baltimore (18%); Detroit (63%); Hartford, Conn. (578%); Los Angeles (118%); Philadelphia (15%); Pittsburgh (113%); San Francisco (71%); St. Louis (255%); and Toledo (84%). In addition to the slight loss shown by New York, losses were reported from

19 More Installations of Webster Air Washers



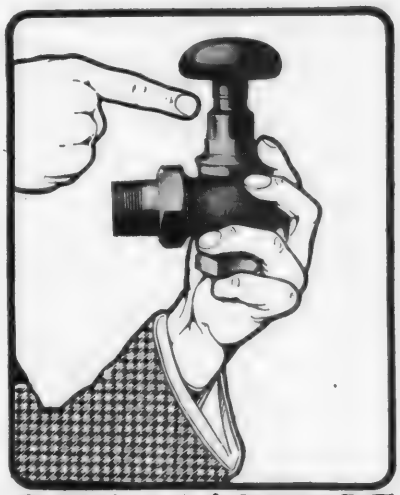
were furnished for the Public Schools of Philadelphia during 1916—after several years' experience with previous installations.

Public and industrial buildings served by Webster Air Washers are assured of a dependable supply of clean, pure air at nominal cost, and when provided with our automatic control system, Webster Washers also maintain any desired temperature and humidity.

Ask for our engineering advice and estimate

BRAEMER AIR CONDITIONING CORPORATION
Lafayette Bldg., Philadelphia, Pa.

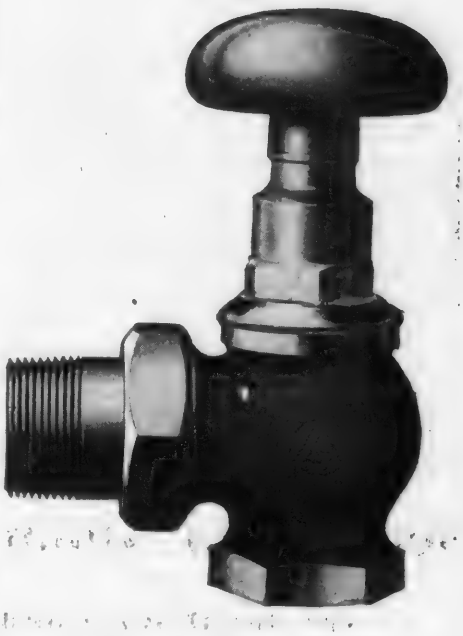
DETROIT PACKLESS RADIATOR VALVES



PERMANENT
• NICKEL •
TRIMMINGS

Detroit Packless Valve trimmings are nickeled before being assembled. The plate is extra heavy, and by a special process is made as permanent as the valve itself.

No other valve is so handsomely plated or has such lasting lustre



Specify Genuine Detroit Packless Valves

DETROIT LUBRICATOR COMPANY
DETROIT, U. S. A.
CANADIAN DETROIT LUBRICATOR COMPANY, LTD. WALKERVILLE, ONTARIO.

LARGEST MANUFACTURERS OF RADIATOR VALVES IN THE WORLD

Chicago (40%); Buffalo (44%); Cleveland (13%); Milwaukee (88%); and Seattle (112%).

New York.—The annual report of the Bureau of Buildings of Manhattan Borough shows that New York fairly outdid itself in the matter of building last year. Plans filed for 1916 provided for the expenditure of 82% more capital than the preceding year. The total for 1916 was $134,078,044, about $20,000,000 of which was for remodeled buildings. The average cost of a building in Manhattan Borough in 1916 was $203,350, as against $132,213 in 1915.

Milton W. Franklin has resigned his position as president of the C. and C. Electric Company, New York, to accept an engagement with E. F. Houghton & Co., Philadelphia, as consulting engineer for the Houghton line. This company not only manufactures the well-known Houghton line of heating specialties, including the Houghton American system of heat control, but is also an extensive manufacture of lubricating and other oils. Mr. Franklin's activities will cover all of the company's products. He will make his head-

Showing Ilg Self-Cooled Motor Propeller Fan Exhausting cid Vapor in a Tannery

I L G

Self-cooled Motor Propeller Fans

Are Ideal for Handling Smoke, Heat, Steam, Dust, Acid Vapors

IN

INDUSTRIAL PLANTS

QUICK SHIPMENTS

I L G ELECTRIC VENTILATING CO.

158 Whiting St., Chicago

Please mention THE HEATING AND VENTILATING MAGAZINE *when you write.*

Tank, Strainer, Removable Screens and Strainer Cover of Sturtevant Air Washer

Sturtevant
(REG. U.S. PAT. OFF.)

AirWashers

are equipped with a strainer that has twice as much area as that of any other make and ten times the area of some.

This consists of a compartment extending the full width of the tank, fitted with mesh screens. The frames of the screens are held in place by galvanized guides and the handles permit them to be readily removed for cleaning. The top of the strainer chamber is closed by hinged doors.

Other mechanical advantages of Sturtevant Air Washers are as follows:

More nozzles per thousand cubic feet of air than any other washer.

Trap in overflow.

Supplies more water to eliminator plates for auxiliary washing than any other apparatus.

Furnished with louver diffuser plates on inlet side.

Write for Bulletin 226-V on Sturtevant Air Washers

B. F. STURTEVANT COMPANY

HYDE PARK, BOSTON MASSACHUSETTS

And All Principal Cities of the World

Stationary Vacuum Cleaners Engines Fans Heaters Motors

quarters at the company's plant in Philadelphia.

American Radiator Company's Berlin branch, known as the National Radiator Gesselschaft has been notified by the German authorities that August Hennig, who was sent to Berlin after the European war started, to fill a vancy on the Berlin staff, caused by the mobilization of the German employees, will not be allowed to leave Germany during the course of the war.

Joseph F. Brightman, general manager of the Syracuse Valve & Faucet Co., Syracuse, N. Y., has joined the sales organization of the C. A. Dunham Co., Marshalltown, Iowa. Mr. Brightman will make his headquarters in Syracuse and will have charge of the Dunham vapor heating system sales in that section.

Manufacturers' Notes.

Warren Webster & Co., Camden, N. J., has elected Frank H. Stevens a director of the company. Mr. Stevens has been assistant treasurer and managing buyer of the company for a number of years.

American Radiator Co., Chicago, Ill., has purchased several plots adjoining its warehouse near Larrabee and Crosby Streets. The purchase, it is stated, was made for possible future requirements and no plans have been made as yet for immediate improvements. As reported last month, the net profits of the company for the year ended January 31, 1917, were equal to over 40% on the common stock. The income account was as follows:

INCOME ACCOUNT.

	1916	1915
Net profit	$2,604,067	$2,364,963
Less dividends—		
Preferred stock	210,000	210,000
Common stock	1,309,696	1,309,696
Balance	$1,084,371	$ 845,257

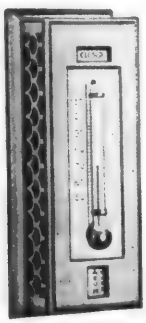
Kewanee Boiler Company (New York branch) has appointed M. William Ehrlich to its sales force. Mr. Ehrlich was formerly associate editor of the *Metal Worker,* New York, and more recently chief engineer for Hersh & Bro., Allentown, Pa.

Warren Webster & Co., Camden, N. J.,

FIRST IN THE FIELD

Automatic Temperature Control for Buildings Originated with the

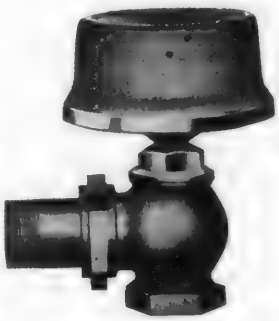
Johnson System of Temperature Regulation



The marvelous little fool-proof Thermostat

While various imitations in the way of regulating devices have been offered to the heating trade, the JOHNSON SYSTEM is the recognized standard.

It costs no more to install the JOHNSON SYSTEM than inferior products, so why assume any risks?



The indestructible sylphon metal diaphragm valve

Communicate with our nearest branch in regard to your temperature regulation requirements Our co-operation is yours for the asking. You can reach us overnight.

THE JOHNSON SERVICE COMPANY

MILWAUKEE, WIS.

Westinghouse

Motors Control

Hill Building

Minneapolis, Minn.

WESTINGHOUSE equipment was selected by the Architects and Engineers for operating the ventilating equipment in this fine building on account of its merits.

Many operating engineers and building superintendents pronounce their entire satisfaction with Westinghouse equipment because of ts reliability and excellent performing qualities.

It will be worth your while to investigate Westinghouse equipment before deciding on your next proposition.

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

W
WESTINGHOUSE ELECTRIC

announces that the Power Equipment Co., 131 State St., Boston, Mass., will represent the company's feed water heater department in New England. This department will be in charge of John Jay, who was previously located at the company's headquarters in Camden.

Lavigne Mfg. Company's Chicago office, which are the headquarters of E. W. Sanborn, western sales manager for the company, have been removed to Suite 640, McCormick Building, Chicago.

H. Mueller & Co., Decatur, Ill., has gone on record as offering the use of its plant to the government in case of war. It is stated that the plant would be especially useful for the manufacture of brass parts of shells which could be assembled and loaded at the Rock Island arsenal.

Atlantic Radiator Company, Huntington, Pa., at its recent annual meeting in Wilmington, elected the following directors: Richard C. Schwoerer, Joseph Bancroft, E. M. C. Africa, A. C. Stein and Howard T. Gates. Richard C. Schwoerer was re-elected president and treasurer; Howard T. Gates was elected vice-president and secretary and was also appointed general manager. Mr. Gates reported a successful year and was given a rising vote of thanks for his management of the business.

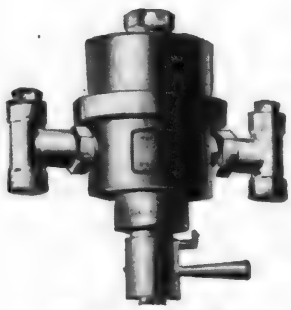
Moline Heat, Moline, Ill., has opened a new branch office at 340 Leader-News Building, Cleveland, O. Harry L. Repp is in charge. An item in the January issue stated that the Moline Heating and Construction Co., Moline, Ill., was now well settled in its new quarters on Third Avenue in the building just erected for the company's use. This should have read "Moline Heat," which is an entirely different business organization. The remainder of the item was correct in stating that from 8,000 to 9,000 installations of "Moline heat" have been made in the United States and Canada.

Toledo Pipe Threading Machine Co., Toledo, O., is building a new addition, 30 ft. x 140 ft. to its plant in Toledo, for manufacturing and warehouse purposes. The company reports that it did 27% more business in 1916 than in any other year in its history. General Manager C. W. Longnecker stated that the prospects for 1917 were even better.

Detroit Valves & Fittings and Detroit Brass Works, Detroit, Mich., is the title of a new firm formed as the result of a consolidation of the Detroit Valve & Fittings Co., Wyandotte, Mich., and the Detroit Brass Works, Detroit. The capital stock of the new organization is $1,500,000. The new officers are: President, E. B. Whitcomb; vice-president and general man-

A Better Business Policy

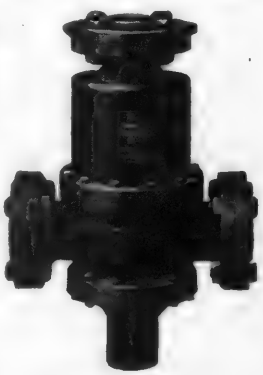
GET after the orders! Don't wait for them to come to you. Study your field, then offer these regulators to the institutions, and individuals you see every day, who can and ought to use them.



Types A and B

Powers Thermostatic Shower Bath and Hot Water Line Controller

On shower baths—individual or in gangs up to 50—this regulator insures against scalding, or a sudden chill. On the hot water line it prevents over heated water, with its waste of fuel, bursted pipes, leaky faucets, and other dangers.



Type C and D

It is a positive thermostatic regulator, guaranteed reliable and automatic.

Write for Bulletin 124 for prices, discounts, and complete information about how you can make some easy money with this specialty.

The Powers Regulator Company

925 Architects Bldg. New York — 2125 Mallers Bldg. Chicago — 325 The Federal St. Bldg. Boston

THE necessity for proper ventilation for night workers is even more eminent than for day workers—because the night shift works under unnatural conditions—

Efficiency Engineers have proclaimed ventilation as a most important factor in getting maximum production at any time—therefore it becomes doubly important where overtime or night work is required.

By actual test Sirocco Ventilating Equipment has been instrumental in increasing production in many types of industrial building.

Efficiency demands many provisions, one of which is good air—that's Sirocco's reason for existence—to condition air according to requirements.

Stability—

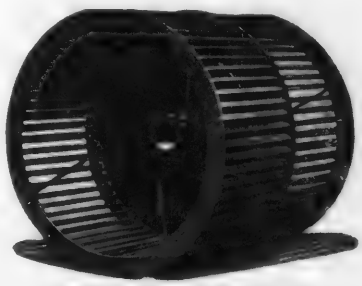
with reference to Sirocco Design and Construction?—also stability in providing a medium which enhances the health of work people—their productive capacities—their attendance record, all of which means profits to your company.

Service

That means after as well as before the installation of Sirocco Equipment.

Before—in applying that size and arrangement of "Sirocco" best suited to your requirements.

After—in seeing to it that our recommendations are suppelmented by actual results.



Double "Sirocco" wheel for confined installation spaces.

Bulletin No. 2704 tells about "Sirocco" installations.

AMERICAN BLOWER COMPANY
DETROIT, MICH.

ager, O. P. Benjamin; secretary, F. L. Uhl; assistant secretary, W. E. Ganley; treasurer, A. L. Hanson; assistant treasurer, D. M. Hamilton.

Pierce, Butler & Pierce Mfg. Corporation, New York, has appointed Mr. Garrard manager of its Brooklyn branch. Mr. Garrard was formerly manager of the Worcester (Mass.) office. He succeeds Mr. Bush, who will act as manufacturers' agent. The Worcester branch will be managed by E. A. Morris of the Boston office.

Wm. H. Page Boiler Co., New York, has established new warehouse facilities at the Bush Terminal, Brooklyn.

Fulton Co., Knoxville, Ky., manufacturers of the Ja-Nar' for enclosing radiators, has opened an office in Chicago in the Insurance Exchange Building. W. D. Bucklin is in charge as local sales manager.

H. W. Johns-Manville Co., New York, has opened a new branch office in Louisville, Ky., at Fourth Avenue and Guthrie Street. A. H. Voight is in charge.

Smith & Anthony Co., Boston, Mass., manufacturers of heating furnaces and boilers, has sold its plant, patterns and manufacturing rights, and has been dissolved. The plant has been purchased by the George A. Gibby Foundry Co., East Boston, and the patterns and manufacturing rights have been sold to the Barstow Stove Co., Providence, R. I. The purchase price for the plant was $12,000, although it was valued at $65,000. The Smith & Anthony Company was one of the oldest manufacturers of warm air furnaces and heating boilers in the country, having been in continuous operation for over half a century. The company employed 123 men. The business was sold out to settle the estate of the late E. W. Anthony.

Pittsburgh, Pa.—The Pittsburgh offices of the Buffalo Forge Company, the Buffalo Steam Pump Company and the Carrier Air Conditioning Company, have been moved to the New Union Arcade, the office building owned by H. C. Frick. H. Lee Moore continues in charge as manager of the Pittsburgh branch.

Connersville Blower Co., Connersville, Ind., announces an increase in its capital stock from $400,000 to $750,000.

Sarco Co. Inc., New York, manufacturer of the Sarco line of steam traps and temperature regulators, has added Buffalo, N. Y., to its list of branch offices. The new office is located at 325 Ellicott Square, and is under the management of F. D. Harger, M.E.

H&M
Tycos
Found in Industries where Efficiency is Paramount
H & M Tycos
THERMOMETERS
An unbroken line of temperature indicating and registering instruments, from the delicate fever thermometer for taking body temperatures to the Fery Pyrometer, registering several thousand degrees.
Line complete and uninterrupted, embracing thermometers for EVERY purpose into which temperature enters. We meet every application, and there are thousands.
Correspondence Solicited
H & M Division
Taylor Instrument Companies
Rochester, N. Y.
There's a Tycos or Taylor Thermometer for Every Purpose

WAINWRIGHT CLOSED TYPE FEED WATER HEATERS

The Wainwright Feed Water Heaters are equipped with straight corrugated copper tubes rigidly expanded in both tube heads, taking up within themselves all temperature expansion.

This construction avoids trouble with floating heads, and permits convenient inspection and replacement of tubes damaged by accident.

The corrugated tube agitates water, giving highest heat transmission ratio, and prevents lime deposit in tubes, as occurs in plain tube heaters and which immediately lowers the efficiency. Separate tube heads, water channels and covers permit easy installation and maintenance.

Send for Bulletin No. 16

ALBERGER PUMP AND CONDENSER CO.

140 CEDAR STREET, NEW YORK

Boston Pittsburgh Chicago St. Louis Philadelphia San Francisco

For Heating, Ventilating, Drying and Mechanical Draft Purposes use the

PLEXIFORM FAN

because of its high efficiency, great strength, lightness and low cost of installation.

Plexiform wheel construction is as a aptable for double width as for single width fans, and is the only type of multiple blade wheel fan that is equally adaptable for high or low pressures without change in design and construction.

We have Fans of standard Plexiform construction handling air at −50 deg. and gases at 1,000 deg. temperature.

Write for catalogs.

BAYLEY MANUFACTURING CO., Milwaukee, Wis.

Make It Mueller

See that this name is on your regulator.

It's a small precaution but it will prove a big benefit to you in service and satisfaction.

13160

The 13160 is an unsurpassed all around valve. It is exceptionally good but it is no better than any other Mueller valve.

Our line is complete. We have a particular type of valve for every kind of service.

Take the question up with us.

H. MUELLER MFG. CO.

Decatur, Ill.

NEW YORK
145 W. 30th St.

SAN FRANCISCO
589 Mission St.

Bacharach Industrial Instrument Co., Pittsburgh, Pa., manufacturers of gas meters, pressure and draft recorders, CO indicators, thermometers, etc., has moved into larger quarters at 422 First Ave., Pittsburgh.

New Incorporations.

City Plumbing & Heating Co., Bessemer, Ala. Among the stockholders are H. H. Milton, J. H. Edwards, D. Lewis Milton, Jr., and David E. Jones. The company has taken quarters at 517 Twentieth Street.

Interstate Plumbing & Heating Co., Boston, Mass., capital $10,000. President, Philip H. Jones, Roxbury; treasurer, Ernest W. Josselyn, Quincy; clerk, Frank G. Montague, Boston.

Stanley Plumbing & Heating Co., Chicago, Ill., capital $10,000. Incorporators: Clarence J. Bean, Elmer C. Lind and H. L. Webster.

Sanitary Heating and Ventilating Co., Indianapolis, Ind., capital $10,000, to design and install heating and ventilating systems. Directors, George Stevanson Stevason, E. W. Kaser and Bert Brockman.

Vermont Plumbing & Heating Co., Brattleboro, Vt., capital $5,000. Incorporators: J. A. Bacon, E. W. Porter and Harold E. Whitney, all of Brattleboro.

Natural Air

Are you planning to give your clients a natural air condition during the heating season?

Not psychological but real humidity may be had under all conditions by using

STEAMO and VAPO AIR MOISTENERS

Tests have shown that the cost of the best evaporating device is 11 times greater for the same quantity of moisture than that of the Steamo Air Moistener.

Single Pipe Type

Send for new catalogue.

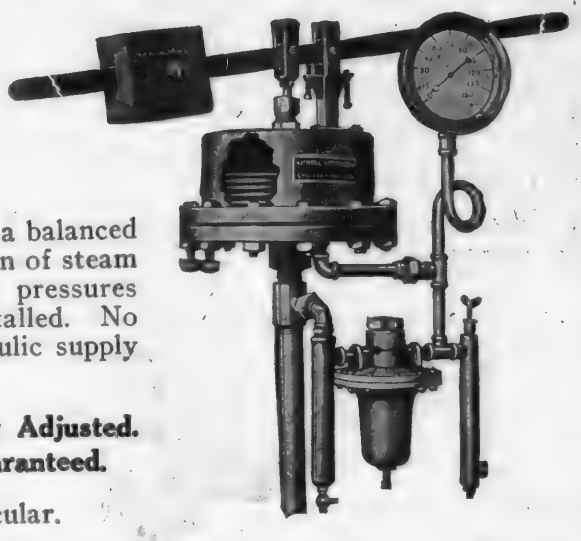
The Air Moistener Co.

28 N. Market St.
Chicago, Ill.

The Metaphram

Here is a simple, sensitive, direct acting

High Pressure Steam Damper Regulator



which will automatically operate a balanced draft damper on a slight variation of steam pressure. Designed for boiler pressures from 15 to 175 lbs. Easily installed. No auxiliary mechanism. No hydraulic supply or waste lines.

All Metal. Dust Proof. Easily Adjusted. Graduated in Its Action. Guaranteed.

Send for Metaphram Circular.

NATIONAL REGULATOR CO., 208-212 Jefferson Street, Chicago

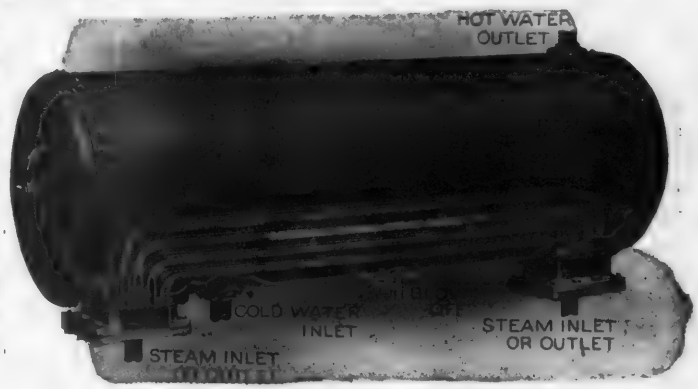
Manufacturers of all types of Automatic Temperature Regulating and Humidifying Apparatus

---

THE ⌐¬ SHAPE TUBES EXPLAIN THE SUCCESS of the

PATTERSON HOT WATER TANK

for heating water for domestic or manufacturing purposes. Both ends of each seamless brass tube are expanded into heavy cast-iron tube-heads with an improved roller expander. Their shape provides for the free contraction and expansion of each individual tube without straining, so there is no danger of leakage.

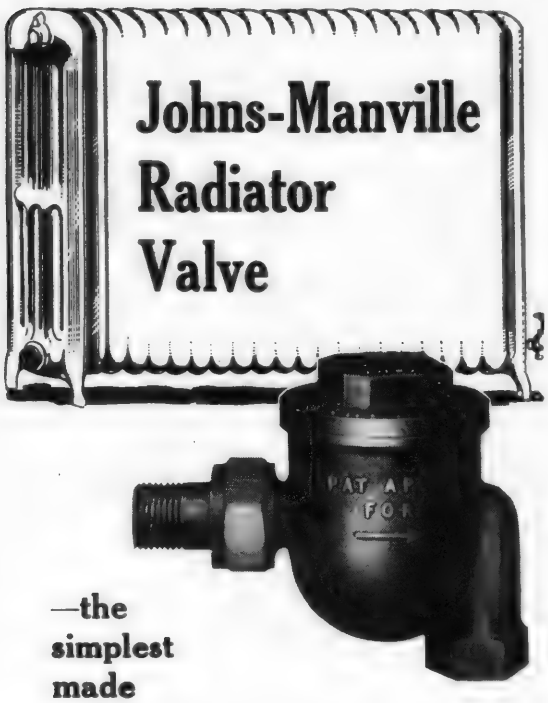


Type C. Patented Aug. 26, 1913.

Any Combination of Storage and Heating Capacities can be Furnished. Send for Catalogue.

FRANK PATTERSON & CO., 26 Cortlandt Street, New York

Representatives in all Principal Cities.



—the simplest made

IT'S the unique simplicity of the Johns-Manville Radiator Valve that first commends it to plumbers, to steam-fitters, to architects, engineers and owners.

Like the well-known Johns-Manville Steam Trap, it has but three parts—body, connecting union and hollow rolling ball. When water enters the trap, the ball rolls up, exposing the discharge orifice and permitting escape of water and air without loss of steam.

Because of its simplicity, the Johns-Manville Radiator Valve operates constantly and positively. Its action is not dependent on temperature change, but solely on volume of condensation. Easy to install, and there's nothing to get out of order, nothing to be tampered with, no adjustments required.

The Johns-Manville Radiator Valve has proved itself in many successful installations, and we stand squarely back of it. You'll find it worth-while to try one out.

Johns-Manville Service Covers the Continent

H. W. Johns-Manville Co.
NEW YORK CITY
10 Factories—
Branches in 55 large cities

East Youngstown Plumbing Co., East Youngstown, O., capital $10,000. The principal stockholder is John C. Dulovich.

Geo. A. Henrich Co., Chicago, Ill., capital $25,000, to conduct a heating contracting business. The principal stockholder is M. Frisch, 6 North Dearborn Street.

Harbison & Wilson Plumbing & Heating Co., Quincy, Ill., capital $10,000. Incorporators: J. C. Harbison, P. C. Wilson and A. D. Harbison.

A. T. Purdy Co., Newton, Mass., to conduct a heating and plumbing business. Incorporators: Arthur T. Purdy, H. A. Buck and G. Purdy, all of Newton.

Worden & Tucker, Inc., Brookline, Mass., heating and plumbing contractors. Incorporators: Jethro H. Worden, I. R. Tooker and L. L. Gould, of Brookline.

Fowler Radiator Co., Dallas, Texas, capital $10,000. Incorporators. F. L. Fowler, M. E. Fowler and I. D. Fowler.

Ernest Mehring Co., Chicago, Ill., incorporated to act as manufacturers' agent for the Kanawha Mfg. Co., the American Press-weld Radiator Corporation and other firms. Officers of the company are Ernest Mehring, A. J. Stone and W. W. Nuss, all of Chicago. Quarters have been taken at 175 West Jackson Boulevard.

John Doyle Plumbing Co., Inc., Albany, N. Y., capital $5,000, to conduct a heating and plumbing business. Incorporators: J. Doyle, W. C. Doyle and M. M. Flinn, 66 Park Ave., Albany.

Dumore Heating and Ventilating Co., St. Louis, Mo., capital $50,000, to conduct a designing and contracting business for heating and ventilating systems. Incorporators: George A. Deemar, Henry V. Deemar, Michael Jerca, John W. Leimberger, John W. Marx and Julian Groszewski.

Business Chances.

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following-named work:

Until April 14, 1917, for the construction of the U. S. Post Office at Burlington, Wis.

Until April 18, 1917, for the construction of the U. S. Post Office at East Orange, N. J.

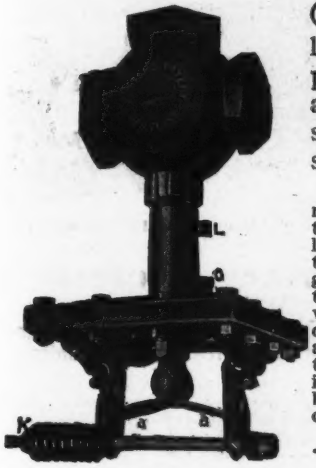
Until April 26, 1917, for the construction of the U. S. Post Office at Fremont, O.

Fort McArthur, Cal.—28 buildings will be erected for the United States Government at Fort McArthur, at a cost of $400,000, in connection with the preparedness programme passed by Congress during the winter.

For Safety, Sureness of Operation and Durability

FOSTER PRESSURE REGULATORS

for STEAM HEATING SERVICE



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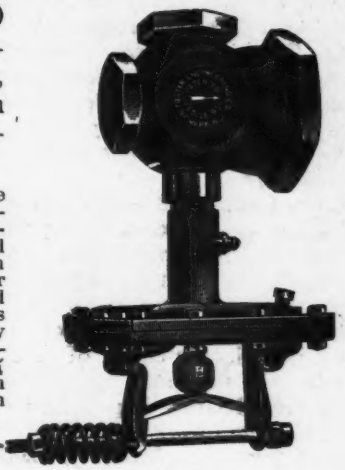

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James H. McGraw is president of the new company. The other officers are: Vice-president and treasurer, Arthur J. Baldwin (formerly president of the Hill Publishing Co.); vice-president and general manager, E. J. Mehren.

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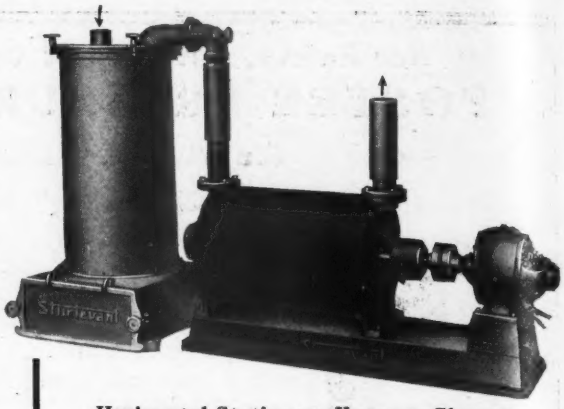

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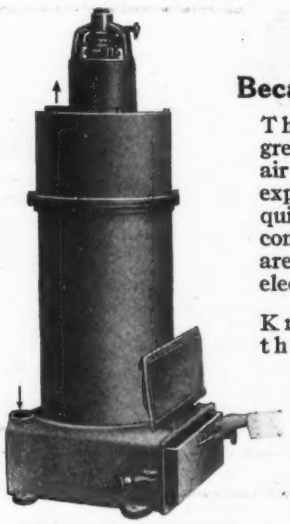

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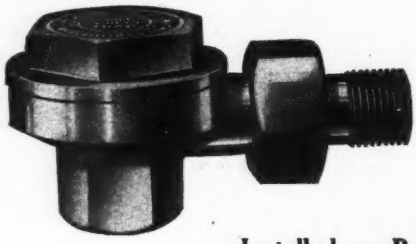

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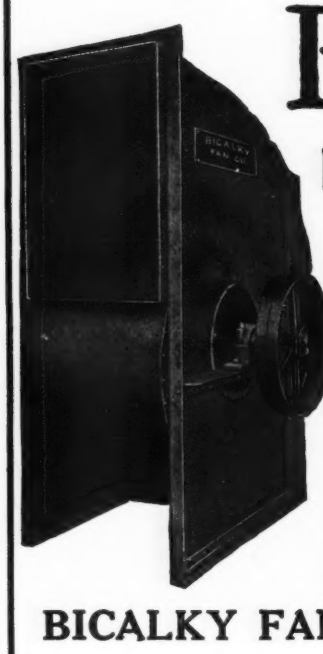

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